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CELESTIAL OBJECTS

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CELESTIAL OBJECTS

FOR COMMON TELESCOPES

BY

THE REV. T. W. WEBB, M.A., F.R.A.S.

VICAR OF HARDWICK, HEREFORDSHIRE

FOURTH EDITION

REVISED AND GREATLY ENLARGED

LONDON

LONGMANS, GREEN, AND CO.

1881

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Many things, deemed invisible to secondary instruments, are plain enough to one who 'knows how to see them' SMYTH

When an object is once discovered by a superior power, an inferior one will suffice to see it afterwards SIR W. HERSCHEL

Inertia mors est philosophiæ—vivamus nos et exerceamur KEPLER

Pulchra sunt omnia, faciente Te, et ecce Tu inenarrabiliter pulchrior, qui fecisti omnia S. AUGUSTINE

To the Memory of

THE LATE VICE-ADMIRAL W. H. SMYTH

K.S.F. D.C.L. F.R.S. ETC.

IN DUE ACKNOWLEDGMENT OF INDISPENSABLE ASSISTANCE

DERIVED FROM HIS MOST VALUABLE

'CYCLE OF CELESTIAL OBJECTS'

The Fourth Edition of this little Work

IS RESPECTFULLY AND GRATEFULLY INSCRIBED

BY

THE AUTHOR

Sic enim magnalia sapientiæ suæ decoravit Is, qui est ante sæculum et usque in sæculum : nihil redundat, nihil deficit, nec locus est censuræ cujusquam. Quam desiderabilia opera ejus! * * * * * et quis saturabitur videns gloriam eorum?

O qui lumine naturæ desiderium in nobis promoves luminis gratiæ, ut per id transferas nos in lumen gloriæ; gratias ago Tibi, Creator, Domine, quia delectasti me in factura tua, et in operibus manuum tuarum exultavi KEPLER

INTRODUCTION.

THE intention of the following treatise is to furnish the possessors of ordinary telescopes with plain directions for their use, and a list of objects for their advantageous employment.

None but an eye-witness of the wonder and glory of the heavens can thoroughly understand how much they lose by description, or how inadequate an idea of them can be gathered in the usual mode, from books and lectures. It is but the narrative of the traveller instead of the direct impression of the scene. To do justice to this noble science,—to appreciate as we ought the magnificent testimony which it bears to the eternal Power and Godhead of Him 'Who by His excellent wisdom made the heavens,' we must study it, as much as may be, not with the eyes of others, but with our own.

This, however, is no easy matter: nor is the want of a telescope the only difficulty. Instruments quite sufficient for the student's purpose are far less expensive than formerly; a trifling outlay will often procure

them, of excellent quality, at second-hand; and many are only waiting to be called into action. But a serious obstacle remains to the inexperienced possessor. How is he to use his telescope in a really improving way? What is he to look for? And how is he to look for it? For want of an answer many a good instrument is employed in a desultory and uninstructive manner, or consigned to dust and inactivity.

Materials for his guidance exist, indeed, in profusion, but some of them are difficult of access; some, not easy of interpretation; some, fragmentary and incomplete: and the student would find it a discouraging task to reduce them into a serviceable form. This, then, is what has been attempted for him in the following pages, by one who, during many years, would have rejoiced to avail himself of some such assistance, if he had known where to meet with it, and who does not know where it is to be met with, in a convenient shape, to the present day.[1]

For the more advanced observer, the 'Cycle of Celestial Objects,' published in 1844 by Captain, now Vice-Admiral Smyth, will be found a treasury of varied information, and of the highest value as the companion of a first-rate telescope: but its very superiority, to say nothing of its bulk and cost, renders it more suitable for his purpose, than for those humble beginnings

[1] The original edition was published in 1859.

which are now in view. It has, however, been of the most essential service in the preparation of the present undertaking, which without it would, in all probability, never have seen the light, and which, as far as the sidereal portion is concerned, is based upon it as the standard authority.

Nothing would have been easier than, on so fertile a subject, to have expanded this treatise to a much larger bulk: but it would thus, in some measure, have defeated its own object. In order therefore to reduce the size of the volume, without omitting such details as may seem to be required by the present state of Astronomy, the reader will have to excuse a condensed mode of expression, the result of necessity rather than of choice; and, as considerable pains have been taken in the verification of facts, a general list of authorities will supersede references at the foot of the page.[1]

Limited in extent, imperfect in execution, and in parts only suggestive in character, this little book may perhaps serve as a foundation, on which students of astronomy may raise the superstructure of their own experience; and in that case the author's intention will be fulfilled. He will be especially gratified, if his endeavour to remove some difficulties may tend to increase the number of those who 'consider the heavens.' For he is convinced that in such a personal examina-

[1] Omitted in the present edition, as its bulk would have been considerably increased, with little correspondent advantage.

tion of their wonders will be found an interesting and delightful pursuit, diversifying agreeably and instructively the leisure hour, and capable of a truly valuable application, as leading to the most impressive thoughts of the littleness of man, and of the unspeakable greatness and glory of the CREATOR. To such a study, the impressive words of the late Sir R. H. Inglis may be most suitably applied: 'Every advance in our knowledge of the natural world will, if rightly directed by the spirit of true humility, and with a prayer for GOD'S blessing, advance us in our knowledge of Himself, and will prepare us to receive His revelation of His Will with profounder reverence.'[1]

[1] Report of British Association, 1847.

ADVERTISEMENT to the FOURTH EDITION.

THE circumstances referred to in the foregoing Introduction have been materially altered since the appearance of the Third Edition, which was itself an enlargement of its predecessors.

The unprecedented diffusion of a taste for astronomical observation during the last seven years has brought with it such a corresponding increase in the optical capacity of telescopes in private hands that the very title of this treatise would convey an inaccurate impression unless its contents were modified in accordance with the requirements of the time.

Without abandoning that elementary character which may still make it serviceable to beginners, its compass must now be greatly extended, if it may hope for acceptance as a manual by the more advanced student; and with this object, as the increase of telescopic range chiefly affects the sidereal portion, recourse has been had for additional Double Stars to the great catalogue of Struve I., as well as in a lesser degree to those of his son and Burnham, and as regards Nebulæ to that of Herschel II., with a total increase of about 1,500 objects, some of which are chosen as tests worthy of the finest instruments, but occasionally, as is

well known, within reach of those of more moderate dimensions.

The amount of care and attention involved in selecting, arranging, classifying, reducing, and passing through the press such a multitude of minute details can hardly be appreciated by those unacquainted with similar tasks, but it may be offered as an apology for the length of time which has elapsed since the last impression was exhausted. It will also in some measure account for the numerous corrections and additions included in the Appendix, Part I.

From circumstances of no public interest, the author has been able to contribute but little from his own memoranda; but, instead of extensive references to known authorities, which could never be superseded by a popular compilation, he has gladly availed himself of much unpublished matter, kindly placed at his disposal; and for assistance in this and other ways he has to offer a very grateful acknowledgment to many friends; the enumeration of whom would not be completed by the names of Birmingham, Burnham, Burton, Denning, Dreyer, Espin, Franks, Hunt, Knott, Neison, Ranyard, Sadler, and Ward. To Mr. Franks especially his sincerest thanks are due for an amount of most willing and effective assistance, in default of which this publication would inevitably have been still longer deferred.

A catalogue of Meteoric Showers will, it is hoped, be found an acceptable addition at the close.

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CELESTIAL OBJECTS.

PART I.

THE INSTRUMENT AND THE OBSERVER.

O multiscium et quovis sceptro pretiosius Perspicillum! an, qui te dextra tenet, ille non rex, non dominus constituatur operum Dei? Vere tu

Quod supra caput est, magnos cum motibus orbes
Subjicis ingenio.—KEPLER.

THE TELESCOPE.

ALTHOUGH the professed design of this volume is to provide a list of objects for common telescopes, it may not be out of place to premise a few remarks upon the instruments so designated.

By 'common telescopes' are here intended such as are most frequently met with in private hands; achromatics with apertures[1] of 3 to 5 inches; or reflectors of somewhat larger diameter, but, in consequence of the loss of light in reflection, not greater brightness.[2] The original observations

[1] 'Aperture' always means the clear space which receives the light of the object; the diameter of the object-glass in achromatics, or the large speculum in reflectors, exclusive of its setting.

[2] Maskelyne estimated the apertures of metallic reflectors and achromatics of equal brightness as 8 to 5. Dawes gives this value for Gregorians, but like Herschel II. rates Newtonians as 7 to 5. Arago strangely asserted that no light was lost in achromatics; but

in the following pages were chiefly made with such an instrument—an achromatic by the younger Tulley, $5\frac{1}{2}$ feet in focal length,[1] with an aperture of $3\frac{7}{10}$ inches, and of fair defining quality; smaller instruments of course will do less, especially with faint objects, but are often very perfect and distinct: and even diminutive glasses, if good, are not to be despised; they will show *something* never seen without them. I have a little hand-telescope, $22\frac{1}{4}$ inches long when fully drawn out, with an object-glass of about 14 inches focus, and $1\frac{1}{3}$ inch aperture: this, with an astronomical eye-piece, will show the *existence* of the solar spots, the mountains in the Moon, Jupiter's satellites, and Saturn's ring. Achromatics of larger dimensions have become much less expensive than formerly, and silvered specula of very considerable size are now comparatively common; even for these it is hoped that this treatise, embodying some of the results of the finest instruments, may not be found an inadequate companion as far as it goes.

In judging of a telescope, we must not be led by appearances. Inferior articles may be showily got up, and the outside must go for nothing. Nor is the clearness of the glass, or the polish of the mirror, any sign of excellence: these

the effects of absorption and reflection are so considerable, that with very large apertures the advantage of the achromatic disappears. The silver-on-glass specula, invented by Foucault and Steinheil, but perfected in England, take their place between the metal Newtonian and the achromatic, approaching more nearly to the latter, especially when the plane mirror is replaced by a prism (which, however, does not always conduce to critical definition). Buffham assigns equal light to silvered Newtonians of 9, $6\frac{1}{2}$, and $4\frac{1}{2}$, and achromatics of 8, $5\frac{3}{4}$, and 4 inches respectively.

[1] The focal length is measured from the object-glass, or speculum, to the spot where the rays cross and form a picture of the sun or any celestial body.

may exist with bad 'figure' (*i.e.* irregular curvature), or bad combination of curves, and the inevitable consequence, bad performance. We need not regard bubbles, sand-holes, scratches, in object-glass or speculum; they merely obstruct a very little light. Actual performance is the only adequate test. The image should be neat and well defined with the highest power, and should come in and out of focus sharply; that is, become indistinct by a very slight motion on either side of it. A proper test-object must be chosen; the Moon is too easy; Venus too severe except for first-rate glasses; large stars have too much glare; Jupiter or Saturn are far better; a close double star is best of all for an experienced eye; but for general purposes a moderate-sized star will suffice; its image, in focus, with the highest power, should be a very small disc, almost a point, accurately round, without 'wings,' or rays, or mistiness, or false images, or appendages, except one or two narrow rings of light, regularly circular, and concentric with the image;[1] and in an uniformly dark field; a slight displacement of the focus either way should enlarge the disc into a luminous circle. If this circle is irregular in outline, or much brighter or fainter towards the centre,[2] or much better defined on one side of the focus

[1] The real diameter of a star in the telescope would be inconceivably small. The apparent or 'spurious' disc, and rings, result from the undulatory nature of light. They seem, however, to be somewhat affected by atmospheric causes. Herschel II. speaks of nights of extraordinary distinctness, in which '*the rings are but traces of rings*, all their light being absorbed into the discs.' I have entered 1852, March 23, as 'a very fine night, though the rings and appendages around the brighter stars were rather troublesome;' 1852, April 1, 'an exceedingly fine night at first, with scarcely a trace of rings or appendages.' See also the star 70 Ophiuchi, in the following catalogue.

[2] The small mirror in a reflector causes a central darkness out of the focus, which should be nearly the same on either side of it.

than the other, the telescope may be serviceable, but is not of high excellence. The chances are many, however, against any given night being fine enough for such a purpose, and a fair judgment may be made by day from the figures on a watch-face, or a minute white circle on a black ground, or the image of the sun on a thermometer bulb, placed as far off as possible. An achromatic, notwithstanding the derivation of its name, will show colour under high powers where there is much contrast of light and darkness. This 'outstanding' or uncorrected colour results from the want of a perfect balance between the optical properties of the two kinds of glass of which the object-glass is constructed: it cannot be entirely remedied, but it ought not to be obtrusive. In the best instruments it forms a fringe of violet or blue round luminous objects in focus under high powers, especially Venus in a dark sky. A red or yellow border would be bad; but before condemning an instrument from such a cause, several eye-pieces should be tried, as the fault might lie there, and be easily and cheaply remedied. Reflectors are delightfully exempt from this defect; and as now made with specula of silvered glass, well deserve, from their comparative cheapness, combined with admirable defining power, to regain much of the preference which has of late years been accorded to achromatics. The horizontal view of objects at all altitudes in a Newtonian reflector with rotating tube is extremely pleasant, when a little experience has been gained in finding and following: the same advantage, however, attends the use of a diagonal eye-piece with the achromatic, but with loss of light. The chief disadvantage of reflectors is the greater aperture, and consequently greater atmospheric disturbance, corresponding with the same amount of light: and the occasional renewal of the film causes a little expense or trouble.

The eye-piece, or ocular, is only a kind of microscope,

magnifying the image formed in the focus of the object-glass or speculum. The size of this image being in proportion to its distance from the glass or mirror which forms it, the power of the same eye-piece in different telescopes varies as the focal length. Hence the disadvantage of a short telescope; to get high powers, we must employ minute and deeply-curved lenses, which are much less pleasant in use; with a telescope twice as long, half the curvature in the eye-piece produces an equal power. The magnified focal image, as in the camera, is always inverted, and so in the astronomical eye-piece it remains.[1] For terrestrial purposes it is erected by two additional lenses; but a loss of light is thus incurred, and as the inversion of celestial objects is unimportant, erecting eye-pieces (always the longest of a set) should never be employed for astronomy; the eye soon becomes accustomed to the inverted picture, and the hand to the reversed motion in following the object. The lateral vision in the Newtonian reflector interposes another difficulty, easily mastered, however, by practice, and by attention to the direction of motion through the field. A multitude of eye-pieces is needless, but three at least are desirable; one with low power and large field, for extended groups of stars, nebulæ, and comets, supplying also, if necessary, the place of a 'finder' for deeper magnifiers; a stronger one for general purposes, especially the moon and planets; and a third, as powerful as the telescope will bear, for minuter objects, especially double stars. A greater number of eye-pieces admits, however, of what is often important—an adaptation of the power to the brightness of the object. Ordinary

[1] It is erect in the Galilean eye-piece and the Gregorian reflector. But the use of the former is almost confined to opera-glasses, as its field with high powers is exceedingly small; and the latter, an inferior construction, is now little employed.

astronomical eye-pieces are shorter in proportion to their power. It is a better plan to change them by means of a short tube, or 'adapter,' than by a screw; in which case they are more liable to be dropped and injured. The power may be much increased by unscrewing and taking away the 'field-lens'—that farthest from the eye; but the centre of the field only will be distinct. The highest powers of large telescopes are sometimes made thus, with single lenses for the advantage of light; but the lens is then turned the other way, convex towards the eye, as it gives sharper vision. Sir W. Herschel used the double convex form, as having shallower curves. The common kind, with two lenses, having the flat side of each next the eye, is called the Huygenian or negative eye-piece: the positive or Ramsden eye-piece has a flatter field, but is not, like the other, achromatic. The interposition of a combination called a Barlow lens raises the power with little loss of light; and as one may be made to suit all the eye-pieces, it doubles the set at a small expense. Browning's achromatic eye-piece, and Horne and Thornthwaite's aplanatic, and the Kellner construction (for large fields) are all excellent in their way. The brightness of the field varies inversely as the square of the power: and hence minute stars are commonly more visible with deep eye-pieces; the reverse, however, for some unknown reason, sometimes occurs.

If the power of our oculars has not been engraved upon them,[1] we may get a fair approximation to it by viewing an equally divided scale at a distance (for low powers, a brick

[1] These figures are not, however, always to be depended upon, and must be wrong if the eye-piece was made for an instrument of a different focal length. The celebrated Short exaggerated the powers of his reflectors: and those of the great achromatics of *Dorpat* and Berlin were found by Struve and Encke to be overrated.

wall will answer) with one eye through the telescope, and with the other alongside of it, and noting how many unmagnified divisions are covered by a single magnified image. Or, better still, we may have recourse to the Berthon Power-gauge, a little apparatus, the simple, efficient, and inexpensive character of which entitles it to very warm commendation.[1]

The test of excellence in separating power has been fixed by Dawes at the quotient, expressed in seconds, of 4·56 divided by aperture in inches. Thus a 10-inch object-glass or speculum ought to separate double stars at 0″·456 of distance between their centres. This value practically concurs with those given by Dallmeyer and Alvan Clark. Reflectors somewhat surpass achromatics in this respect, as theoretically they ought to do: but they are apt to be more troubled by rings and flare, and scattered light. The best telescopes of either kind will bear a power of 100 per inch of aperture on stars: for planets, or the moon, half that power will usually more than suffice.

An object-glass of inferior definition may sometimes be improved by stopping out defects, or contracting the aperture. Streaks or specks of unequal density are very injurious: they may be detected by turning the telescope to a bright light, taking out the eye-piece, and placing the eye in the focus; every irregularity will then be visible in the illumination which overspreads the object-glass; and, if of small extent, may be stopped out by a bit of sticking-plaster. If the performance is not thus improved, try a contracted aperture: make a cap of pasteboard fitting over the object-glass like the usual brass cap, but with a circular opening a little less than the clear aperture;—if the indistinctness is

[1] It may be purchased for 7*s.* 6*d.* of Mr. Tuck, watchmaker, Romsey. See *English Mechanic*, March 5, 19, April 9, 1880, respecting an excellent method of employing it.

thus diminished, but not removed, try several discs of pasteboard placed successively within this cap, with progressively contracted openings, till distinct vision is obtained; there we must stop, or valuable light will be lost. An excentric opening in the pasteboard disc may sometimes be serviceable, being turned round the axis so as to expose different parts of the glass or mirror, till the best effect is produced: in other cases, a central pasteboard disc, supported by narrow arms from the sides, and leaving an open ring of light all round, may be tried. But for comets or nebulæ, it will be best to restore the original aperture, as with faint and ill-defined objects light is more essential than distinctness. The centring of a reflector is more liable to derangement than that of an achromatic; it is, however, easily rectified by the cautious use of the screws which are provided for the purpose. When in correct adjustment, the eye-piece being removed, a dark spot will be seen in the centre of the small mirror, which is the image of that mirror reflected by the large speculum: in proportion as it deviates from a central position, the adjustment is incomplete, and the performance defective.

The definition of reflectors may often be greatly improved by the use of a tube perforated with large and numerous openings; it is also desirable, where practicable, to interpose between the observer and the instrument, in cold weather, a moveable screen of felt or some non-conducting material.

A good stand is essential: if unsteady, it will spoil the most distinct performance; if awkward, it will annoy the observer; if limited in range, it may disappoint him at some interesting juncture. It may be well left to a respectable optician; but where expense is a serious consideration, a little mechanical ingenuity and knowledge of such contrivances will devise one which will answer sufficiently. The old arrangement, with a vertical and horizontal, or 'altitude

and azimuth' motion, is simple and manageable: the equatorial form, which makes the telescope revolve on an axis parallel to that of the earth, has great advantages, in following the object by a single motion, and where the expense of divided circles and spirit-levels is admissible, in finding planets and bright stars by day, and identifying minute objects by night: but, to do its work, it must be placed accurately in the meridian, and out of that position has little superiority. The tube, too, must rotate in a cradle, or the ocular will assume very awkward inclinations. In any case, if the stand is to be moveable, let it be strong enough for steadiness without being too heavy for portability.[1]

A sidereal clock is often considered a necessary adjunct to an equatorial mounting, in order to find objects invisible to the naked eye. But it may be dispensed with by the following method of 'differentiation' in all cases, excepting during the brief season of twilight, when neither sun nor stars can be employed. Write down the difference of Right Ascension (taking particular notice whether additive or subtractive) between the required and some known object—the sun by day, a neighbouring bright star by night. Seek the known object by the finder, and place it in the centre of your largest field: clamp the R. A. circle: set the telescope to the declination of the object sought, and clamp it there: unclamp in R. A. and move the telescope E. or W. as the case requires, to the value of the ascertained difference in

[1] A very cheap equatorial stand is described in *Astron. Register*, xiv. 35. Franks observes that a common equatorial mounting may be made very efficient at a trifling expense by the addition of plain metal circles, on which slips of paper graduated with pen and ink are fastened by glue dissolved in strong acetic acid, and afterwards sized and varnished. A good pillar-stand may be made by letting a 4-inch iron pipe deep into the ground, in which a small table with a long foot revolves.

R. A. and the object will be found in the field, somewhat W. of the centre, by a distance dependent on the duration of the process.

An observatory is by no means essential, but it would be difficult to over-estimate its advantage in point of comfort as well as economy of time. It used to be an expensive luxury; but a very simple and cheap 'telescope-house,' combining shelter with open-air freedom, to the great merit of which I can bear full testimony, has been devised by the Rev. E. L. Berthon, and is described in the *English Mechanic*, Oct. 13 and 20, 1871. The Rev. W. Conybeare Bruce has also handled the subject very ably in the same publication, Feb. 6 and 27, and April 2, 1880.

We will close this section with the encouraging words of the Council of the Royal Astronomical Society, in their Report for 1828: 'Every one who possesses an instrument, whose claims rise even not above a humble mediocrity, has it in his power to chalk out for himself a useful and honourable line of occupation for leisure hours, in which his labour shall be really valuable, if duly registered; . . . those who possess *good* instruments, have a field absolutely boundless for their exertions.'

THE MODE OF OBSERVATION.

AN ordinary telescope may be easily prepared for use: to fix it on its stand; to point it by means of the finder; to adjust the focus to the eye (remembering that different eyes require different adjustments), are processes scarcely requiring instruction. But many mistakes may be made in detail; and in this, as in everything else, there are various methods

of doing the thing the wrong way. The present section will therefore consist of negative rather than positive directions, pointing out rather what should be avoided than what should be done.

1. Do not begin by fixing the telescope in a warm room and opening the window. A boarded floor is bad, as every movement of the observer is liable to produce a tremor; but the mixture of warm and cool currents at the window is worse; it is an artificial production of the fluttering and wavering which, as naturally existing in the atmosphere, are such an annoyance to astronomers. If a window must be used, let it be opened as long beforehand as may be, and let the object-glass be pushed as far as possible outside; there should be no fire in the room; and any other windows, as well as the door, should be shut before beginning to observe: the nuisance may thus be sometimes abated; but the right place is unquestionably out of doors.

2. Do not wipe an object-glass or metallic speculum more than can possibly be helped. Hard as the materials are, scratching is a very easy process; and the ultimate result of ordinary wiping may be seen in an old spectacle-glass held in the sunshine. The most valuable part of a good telescope deserves much more careful treatment; and, if protected from dust and damp, it will very seldom require to be touched. Nothing but great carelessness would expose it to dust: and the dewing of the surface may be almost always avoided. The object-glass or speculum, if kept in a cold place, should not be uncovered, if possible, in a warmer air till it has gained something of its temperature; and it must be invariably closed up in the air in which it has been used before it is removed in-doors; or, in either case, it may be dewed like a glass of cold water brought into a heated room. The object-glass, however, being much exposed to radiation,

requires additional protection; and this may be easily contrived. A tube of tin, pasteboard, or very thin wood, such as is used for hat-boxes, or, best of all, calico stiffened with shell-lac and varnished, fitting on to the place whence the brass cap has been removed, and three or four times longer than wide, will, in general, keep the object-glass bright. This 'dew-cap' must fit tight enough to stand firm, or it will bend down and intercept the light; but not so tight as to cause trouble in removing it to put on the brass cap in the open air. It is better to blacken its interior—indeed, necessary, if of tin; this may be done with lamp-black mixed with size or varnish, so as neither to show a gloss nor rub off; or a piece of black cloth or velvet may be glued or pasted inside it. A lining of blotting-paper is serviceable in heavy dew. A dew-cap on the finder will often save much trouble. Should it be necessary to leave the telescope for some time in the cold, a clean handkerchief thrown over the end of the dew-cap will be a complete safeguard. Should an object-glass or speculum become damped after all, do not close it up in that state; if the cloud of dew is very slight, it may quite disappear in a warm room, especially if exposed to a fire; if dense, however, it may leave a stain which ought to be quickly removed, as well as any little specks of dirt or dulness which will form, one knows not how. To do this, dust the dried surface first with a soft camel's hair pencil or varnishing brush, which will remove loose particles; then use, very cautiously, a very soft and even piece of chamois leather, which has not been employed for any other purpose, and must be always kept in a wide-mouthed stoppered bottle or wrapped up from dust; or a very soft silk handkerchief (which Lassell uses for glass) preserved with similar care. But the wiping must be as gentle as possible; rubbing is *inad*missible in any case. Proctor advises sweeping from a

small space near the edge as a centre. Any refractory stains may be breathed upon, or touched with pure alcohol, and wiped till dry: but if the glass has become discoloured, we must put up with the defect; and care should be taken not to mistake specks in the substance of the glass for foreign matters lodged on its surface. A slight tarnish may frequently be removed from a metallic speculum by lemon-juice, or a solution of citric acid, or spirit of hartshorn, carefully wiped off in a short time: if this does not restore its brightness, it is better to leave it alone; a slight loss of light is not so great an injury as would result from strong friction. The taking out or replacing of an object-glass or mirror is a delicate operation, and hurry or carelessness may easily make it a very dangerous one; speculum metal is nearly as brittle as glass: but this material is rapidly going out of use, from the superiority of the silver-on-glass mirrors, which are now becoming appreciated as they deserve. The management of these need not be described here, as special instructions should always accompany them, such as will be found in Browning's 'Plea for Reflectors,' or Calver's 'Hints for Reflecting Telescopes.'

Dimness of vision often results from damp on the eye-lens. This will rapidly disappear, without wiping, in a warmer temperature. If the finder does not act well, this may be suspected to be the cause. For these and many other reasons, a small lamp, the light of which can be concealed at pleasure, is a convenient adjunct to the telescope: any glass surface held at a safe height over it will speedily be cleared of moisture. A ground or papered glass front to a lamp is advantageous for reading.

Eye-piece lenses require occasional wiping; the leather may be pressed to their edges with a bit of soft wood. A piece of blotting-paper rolled to a point, and aided by breath-

ing, answers perfectly. Their flat faces are easily scratched if laid downwards on a table. The screws demand very gentle usage: a previous turn backwards, before screwing in, causes the thread to fall with a snap into its place.

Brass-work should not be rubbed with polishing powder, which might injure the lacquering: ammonia is preferable.

3. If the telescope does not seem altogether right, notwithstanding all the pains you can take in bringing it to focus, do not meddle with screws or adjustments, unless you thoroughly understand the construction, or can obtain good directions. In most cases a screw-driver is a dangerous tool in inexperienced hands.

4. Do not use any part of a telescope or stand roughly, or expose it to any blow or strain. It is a delicate instrument, and well deserves careful preservation.

5. Do not spare trouble in adjusting the focus. It is well known that different eyes require a change, sometimes a great one: and the same observer's focus is not invariable, being affected by the temperature of the tube and the state of the eye, the adjustment of which, as Dawes has pointed out, shortens with intense gazing, and is apt to vary with the relative brightnesses of objects, besides being, to a certain extent, under the observer's control.

6. Do not over-press magnifying power. Schröter long ago warned observers against this natural practice, which is likely to lead beginners into mistakes. A certain proportion of *light* to *size* in the image is essential to distinctness; and though by using a deeper eye-piece we can readily enlarge the size, we cannot increase the light so long as the aperture is unchanged; while by higher magnifying we make the inevitable imperfection of the telescope and the atmosphere more visible. Hence the picture becomes dim and indistinct beyond a certain amount of power, varying with the bright-

ness of the object, the goodness of the telescope, and the steadiness of the air. Comets and nebulæ, generally speaking, will bear but little magnifying. For the moon and planets, the power should be high enough (if the weather is suitable) to take off the glare, low enough to preserve sufficient brightness and sharpness: the latter condition being preserved, minute details are likely to come out better with an increase of power. Stars bear much more magnifying, from their intrinsic brilliancy; and they are enlarged very slightly in proportion: their images ought never, with any power, to exceed the dimensions of minute discs,—*spurious discs*, as they are termed, arising from the undulatory nature of light, and usually smallest in the best telescopes. A very high power has, however, so many disadvantages, in the difficulty of finding and keeping the object, the contraction of the field, the rapid motion of the image (in reality, the magnified motion of the earth), and the exaggeration of every defect in the telescope, the stand, and the atmosphere, that the student will soon learn to reserve it for special objects and the finest weather, when it will sometimes tell admirably. A very low power is apt to surround bright objects with irradiation, or glare. Experience in all these matters is the surest guide.

It may be very useful to know the diameter of the field of each of our eye-pieces. This may be obtained from the time which an object in or very near the equator takes in passing *centrally* through it: any star having but little declination will answer (γ *Virginis* and δ *Orionis* may be especially mentioned), or the moon or a planet in a corresponding position. Several trials may be made, and the mean result in minutes and seconds of time multiplied by 15 will give the diameter of the field in minutes and seconds of arc, or space, at the equator.

7. Do not be dissatisfied with first impressions. When people have been told that a telescope magnifies 200 or 300 times, they are often disappointed at not seeing the object apparently larger. In viewing Jupiter in opposition with a power of only 100, they will not believe that he appears between two and three times as large as the moon to the naked eye; yet such is demonstrably the case. There may be various causes for this illusion;—want of practice,—of *sky-room*, so to speak,—of a standard of comparison. A similar disappointment is frequently felt in the first impression of very large buildings; St. Peter's at Rome is a well-known instance. If an obstinate doubt remains, it may be dissipated for ever when a large planet is near enough to the moon to admit of both being viewed at once—the planet through the telescope, the moon with the naked eye.

8. Do not lose time in looking for objects under unfavourable circumstances. A very brilliant night is often worthless for planets or double stars, from its blurred or tremulous definition; it will serve, however, for grand general views of bright groups or rich fields, or for irresolvable nebulæ, which have no outlines to be deranged: a hazy or foggy night will blot out nebulæ and minute stars, but sometimes defines bright objects admirably; never condemn such a night untried. Twilight and moonlight[1] are often advantageous, from the diminution of irradiation. Look for nothing near the horizon; unless, indeed, it never rises much above it; nor over, or to the leeward of a chimney *in use*, unless you wish to study the effect of a current of heated air. If you catch a really favourable night, with sharp

[1] Secchi has found the detail of the Great Nebula in Orion much more visible in moonlight, which is also known not to obliterate even such objects as the satellites of Mars and Uranus, or some of the minuter *comites* of double stars.

and steady vision, make the most of it; you will not find too many of them. Smyth, who thinks our climate has been unfairly depreciated, says: 'Where a person will look out for opportunities in the mornings as well as evenings, and especially between midnight and daybreak, he will find that nearly half the nights in the year may be observed in, and of these sixty or seventy may be expected to be splendid.' But ordinary students must of course take their chance, with their fewer opportunities. With due precaution as to dress, nothing need be feared from 'night-air:' that prejudice is fully confuted by the well-known longevity of astronomers, even of such as have habitually protracted their watchings

Till the dappled dawn doth rise.

9. In examining faint objects, do not prepare the eye for seeing nothing, by dazzling it immediately beforehand with a lamp, or white paper. Give it a little previous rest in the dark, if you wish it to do its best.[1]

10. When a very minute star or faint nebula is not to be seen at once, do not give it up without trying *oblique* or *averted vision*, turning the eye towards the edge of the field, but keeping the attention fixed on the centre, where the object ought to appear; this device, with which astronomers are familiar, is often successful; its principle depends probably on the greater sensitiveness of the sides of the retina.

11. Do not avoid the trouble of recording regularly all you see, under the impression that it is of no use. If it has no other good effect, it tends to form a valuable habit of accuracy; and you might find it of unexpected importance. And, like old Schröter, *trust nothing to memory*. If there

[1] Herschel II., when about to verify his father's observations on the satellites of Uranus, prepared his eye with excellent effect, by keeping it in utter darkness for a quarter of an hour.

has been haste—and sometimes if there has not—it is surprising what unforeseen doubts may arise the next day: make at least rough notes at the time, and reduce them speedily into form, before you forget their meaning.

12. Do not be discouraged, by ignorance of drawing, from attempting to represent what you see. Everybody ought to be able to draw; it is the education of the eye, and greatly increases its capacity and correctness; but even a rough sketch may have its use; taken on the spot, and compared with the original, it will not be all untrue; it may secure something worth preserving, and lead to further improvement.

In conclusion, may I be permitted to remind the young observer not to lose sight of the immediate relation between the wonderful and beautiful scenes which will be opened to his gaze, and the great Author of their existence? In looking upon a splendid painting, we naturally refer its excellence to the talent of the artist; in admiring an ingenious piece of mechanism, we cannot think of it as separate from the resources and skill of its designer; still less should we disconnect these magnificent and perfect creations, so far transcending every imaginable work of art, from the remembrance of the Wisdom which devised them, and the Power which called them into being. Such is eminently the right use of the Telescope—as an instrument, not of mere amusement or curiosity, but of a more extensive knowledge of the works of the Almighty. So new an aspect as has thus been given to the material universe—so amazing a disclosure as has thus been permitted to man, of the vastness of his Maker's dominion—can hardly be ascribed to blind accident or human contrivance: in thus employing Galileo's invention, we may well feel his grateful acknowledgment, that it was the result of the 'previous illumination of the Divine favour,'[1] to have *been not only* beautiful, but true.

[1] *Divina prius illuminante gratia.*

PART II.

THE SOLAR SYSTEM.

O domus luminosa et speciosa, dilexi decorem tuum, et locum habitationis gloriæ Domini mei, fabricatoris et possessoris tui!—ST. AUGUSTINE.

THE SUN.

THE solar phænomena are especially wonderful. The unrivalled pre-eminence of that glorious sphere, the dependence of our whole system upon the mysterious processes developed at its surface, the rapid and extensive disturbances of which it is the scene, as well as (in fine weather) the daily visibility of the object, all combine to invite research. But the student had better not begin here: more than one astronomer has suffered from that piercing blaze: Galileo probably thus blinded himself wholly, and Herschel I. in part. With due precaution, there is no danger; but the eye and hand had better first acquire experience elsewhere. Much depends on the dark glass of the solar cap which is to be screwed on the eye-piece; red is often used, but is not always dark enough, and transmits too much heat; green is cooler, but seldom sufficiently thick. The Germans have employed deep yellow. Herschel I. adopted, with great success, a trough containing a filtered mixture of ink and water. Cooper, at Markree Castle, Ireland, used a 'drum' of alum water and dark spectacles, and could thus endure the whole

aperture, $13\frac{3}{10}$ inches, of his great 25-foot achromatic.[1] With large apertures, a plane surface of unsilvered glass placed diagonally, as originally suggested by Herschel II., so as to reflect only a small fraction of the light and heat, is found of eminent service. Merz, of Munich, has so reduced the light by polarisation at four such surfaces, that a dark glass, the tint of which is of course better dispensed with, becomes unnecessary; and the same end is attained in a very ingenious double-prism eye-piece devised by Prof. Pickering: neither apparatus, however, is free from accidental colour. An eye-piece constructed by Andrews with two lenses of complementary tints, burnished in loosely to avoid fracture from expansion, has succeeded with a small aperture. In screen-glasses combinations of colour are good. Red succeeds perfectly with green, or with green and blue. Herschel II. used green and cobalt blue.[2] A Barlow lens, carefully silvered, is said to act admirably, though a light screen might still be necessary. If there is to be only one solar cap, deep bluish grey, or neutral tint, will be quite satisfactory; if several, it would be worth while to have different colours, Secchi's observations at Rome seeming to show that the visibility of very delicate details may depend on the tint. In the absence of a proper screen, smoked glass may be used: it is said to intercept heat very perfectly, by Prince, who places it within the eye-piece, close to the 'stop,' or circular opening, which bounds the field; but thus it can have only

[1] Not, however, an example to be imitated. Dawes thought that with a focus of 30 inches, 2 inches of aperture were enough for perfect security. A $4\frac{1}{2}$-inch silvered mirror is not safe for screen-glasses.

[2] The value of complementary, or at any rate dissimilar, tints in protecting the eye was known before the telescope. Fabricius observed a solar eclipse in 1590 'per duplex diversi coloris vitrum;' *and Apian speaks* of them 50 years earlier.

one degree of depth, and must be taken out to view other objects. A strip of glass may be smoked to different densities in different parts, and held between the eye and eye-piece; but it should be protected from rubbing by a similar strip of glass placed over it, and kept from touching by bits of card at the corners, the edges of the two strips being bound round with gummed slips of paper, or tape.[1] Where expense is not regarded, an optician will provide a delightful graduated screen with two wedges of glass, plain and coloured. A more complete command may be obtained by two such wedges sliding behind one another in a brass cap. In any case we should not begin with too faint a shade, but try the deepest first, and change it if necessary. The thickness of any external screen will contract the field much, unless the eye is brought as close up as possible. A pleasanter view is obtained by placing the screen within the adapter, but from its larger surface it will require to be worked very true.

To bring the Sun into the field, do not attempt to look for it with the finder unless it has a solar cap: point the telescope till the finder shows it centrally on the hand, or on a paper held behind it; or bring it to shine through the eye-piece *before* the dark cap is screwed on.

With these precautions, there need be no fear for an ordinary sight, though long and uninterrupted observation is not desirable, from the heat of the screen so near the eye; on which account, when not in actual use, the telescope should be pointed a little on one side. Should the light or heat be still unpleasant, the aperture may be contracted as recommended for defective glasses,[2] or, for a

[1] Gum-water or mucilage should always be made with *cold* water. It is far stronger, and keeps for a long time without growing mouldy.

[2] Schwabe used a contracted aperture and light screen; Her-

very sensitive eye, or a whole company at once, the image of the Sun may be received direct from the eye-piece, without any screen, on card. Choose a field large enough to take in the whole disc, and alter the focus till the image on the card is *quite* sharp, and at a convenient distance as to size; any spots then visible will be easily and, with due precaution, very fairly seen. And so will specks of dirt in the eye-piece; but these may be detected by moving the tube, as the true spots alone will keep their places in the image. If the eye-piece includes only part of the Sun, do not mistake the edge of the field as shown on the card for the Sun's limb; both are circular, but the latter only will move so long as the telescope is fixed. If a circle of suitable size is drawn on the card, and crossed by lines forming small squares, the image may be adjusted to coincide with it, and the progress of the spots may be marked and recorded day after day. Noble has found that plaster of Paris, smoothed while wet on plate-glass, gives a most beautiful picture; he fixes a disc of it inside the base of a pasteboard cone, blackened within, 1 foot long, and 6 inches across the large end; the small end being opened so as to fit close on the eye-piece, with a hole in the side of the cone to look at the image. Howlett prefers the projected picture to a direct view. It has at any rate the advantage of avoiding the tinge given by a screen-glass. In either mode of observation, if an achromatic is employed, it is an excellent plan to shade the face in the one case, or the screen in the other, by a large piece of pasteboard with a hole in it, through which the tube passes.

schel I. and Dawes preferred full apertures and deep screens, for sharper definition. A small aperture has, however, one material advantage in preserving the screens from cracking. I have known a double screen demolished in a few seconds; partial fusion also, *or blistering, may* be produced by a large aperture.

All being arranged, we shall find four points especially worthy of attention: 1, the dark spots; 2, the faculæ; 3, the mottled appearance; 4, the transparent atmosphere.

1. The *Dark Spots*. These are not always visible; the disc is occasionally entirely free from them, but more frequently one or more will be in sight. Unless very small, they generally consist of two perfectly distinct parts—a dark 'umbra,' usually termed the 'nucleus' by the older observers, often very irregular in its outline,[1] which resembles, as Secchi remarks, the creeping of a very dense luminous material over an extremely rough surface; and a surrounding 'penumbra' (the 'umbra' of former days), a fainter shade with an equally definite, but in general less angular boundary, usually, according to Schwabe, in proportion to the umbra as 2 to 1, or as 7 to 3. The umbra appears black from contrast, but is not quite so, as is evident when Mercury in transit, or the limb of the Moon in an eclipse, passes near it. In such a juxtaposition, during the eclipse of July 1860, Dembowski found the lunar disc perfectly black, the umbra 'brun foncé.' Frequently the umbra is slightly and unequally illuminated, as if partially overspread by a thin haze, which Secchi compares to cirri, or mare's-tail clouds, and finds to be the harbinger of its decrease and extinction; sometimes it is intersected by narrow white veins, or bridges; these Huggins has occasionally found of especial brilliancy, and in one of them Secchi detected by the spectroscope a different constitution from that of the photosphere. In Dawes's very in-

[1] A double flexure, like that of the letter S, is not unfrequent. It was noticed by Messier in the great spot of 1759 (the colour of which, he says was 'brun foncé'); and in modern times by Chacornac and others. Howlett remarks this curve in the grouping of small spots.

genious solar eye-piece,[1] a sliding plate, or wheel, of metal contains a series of holes gradually decreasing in size, each of which may limit the field in turn, while the whole is insulated by ivory, so as to prevent the eye-piece from getting heated; thus most of the luminous part may be shut off, and the spot alone viewed with a very light screen-glass. In this way, he detected in all large[2] and many small umbræ, a perfectly black spot, or opening, of much smaller size, which he termed the 'nucleus,' and the presence of which, he believed, might point out an important difference in the origin of the spots. Secchi, who concurs in this discovery, finds that holes in a glazed visiting-card (which may be burnt with a red-hot needle) answer well: the card, however, should be placed a little way from the focus, or the edges of the hole may be charred. A Barlow or even common concave lens, interposed before the rays reach the focus, will divert a great portion of the heat, and an excellent amateur arrangement may be made by a combination of concave lens, card diaphragm, and screen-glass. Howlett and others have occasionally perceived the nuclei without any such assistance, and Buffham has seen them frequently with a $2\frac{9}{10}$ in. object-glass; often multiple; once (1870, June 20) 5 in a single umbra: Huggins finds frequently 3. The feeble illumination of the umbra Dawes ascribed to the presence of a 'cloudy stratum' beneath the photosphere: this Secchi, with Merz's polarising apparatus, finds tinged with a rosy hue. The most

[1] A similar idea had been entertained by Professor Wilson, of Glasgow, in the last century, who thought a screen would not be necessary. But Langley says that even the darkest part would be insupportable to the naked eye.

[2] He mentions, however, one large and unusually changeable spot, in which he could detect no nucleus (1859). Brayley observes that they had been already figured by Herschel II. at the Cape.

diligent of solar observers, Schwabe of Dessau, has seen an occasional reddish-brown colour in spots, whose immediate contiguity to others of the ordinary greyish-black precluded deception; in one instance, three telescopes, and several by-standers, agreed as to this fact. Capocci, in 1826, perceived a violet haze issuing from each side of the bright central streak of a great double umbra: Secchi, during the eclipse, 1858, March 15, remarked a rose-coloured promontory in a spot visible to the naked eye. Schmidt records many tints, chiefly violet umbræ and yellowish penumbræ, especially as cast on paper; Howlett and others have noticed brown, and Lockyer copper-coloured and violet, tints in umbræ.[1] Birmingham has also seen a red cloud suspended, apparently, across an umbra and nucleus. The penumbra—which in most cases encompasses considerable umbræ, occasionally comprises a group of them, and frequently outlasts them—is made up, according to Schwabe, of a multitude of black dots usually radiating in straight lines from the umbra. Secchi, with greater optical power, finds these radiations to be alternate streaks of the bright light of the photosphere and dark veins converging to the umbra. The penumbra, Herschel II. observes, occasionally shows 'definite spaces of a second depth of shade;' it is generally darkest at the outside;[2] an appearance which is proved by photography to be no illusion from contrast; sometimes it includes brilliant specks, or streaks, even close to the umbra. Schmidt describes one of these insulated specks as the brightest portion at that time visible.

[1] An 'over-corrected' object-glass might possibly cause a violet tinge; and the strong influence of contrast must, at least in some cases, be taken into account.

[2] This was figured by La Hire as far back as 1700. Dawes found it to be the case with his cloudy stratum also, but only in opening spots. Buffham and Andrews have seen a nucleus encompassed by a narrow grey ring.

They have been frequently seen to disappear in floating over the umbra. Sun-spots are of all shapes and sizes, up to enormous dimensions, the umbra frequently surpassing the earth greatly in magnitude. The penumbra, especially of a group, is often much larger. Herschel II., at the Cape of Good Hope, estimated the area of one to be 3,780,000,000 square miles. Schwabe and Schmidt speak of groups which have extended across more than a quarter of the disc. The length of one, observed by Hevel in 1643, is said to have occupied one-third of it. Spots exceeding 50″, Schwabe finds visible to the naked eye through a fog, or dark glass: he has often recorded such instances, sometimes repeatedly in 12 months; and Dawes states that a year seldom, if ever, passes without them. When thus perceptible they surpass the earth at least 3 times—if conspicuous, much more. A gregarious tendency is obvious, and the groups are apt, especially in certain seasons, to be nearly parallel with the solar equator. Herschel II. says that, if they converge, it will be towards the preceding side of the disc. They are absent from the poles, and infrequent and of short duration for about 10° on each side of the equator: beyond this region are two fertile zones, reaching as far as 30° or 35° each way; sometimes they exceed these bounds. Peters (U.S.) saw one in 50° 55′, La Hire in 70°, of solar latitude (if correctly reduced, which Carrington thinks questionable). The observations of Peters and Carrington tend to unsettle these limits, which may be subject to change: the latter astronomer has ascertained that, previous to the minimum epoch, the spots break out nearer to the equator, and the reverse afterwards. The numbers are said to be greater in the N. than S. hemispheres. Schwabe finds that the W. members of a group disappear first, and new ones are apt to form on the other *side, on* which are the greatest number of minute companions,

and on which the spots themselves generally increase, decreasing the opposite way; also that the small points are usually arranged in pairs; and that, near the edge of the Sun, the penumbræ are much brighter on the side next the limb. Herschel II. saw the penumbræ often best defined on the preceding side; and Capocci found that the principal spot of a group leads the way, and that the umbræ are better defined in their increase than diminution. Peters and Carrington observe a remarkable tendency to divergence in adjacent umbræ. Groups are frequently elliptical, curvilinear, or bifurcated. The extraordinary mutability of the spots will be obvious; frequently they are in continual change, varying from hour to hour, and even more rapidly. Herschel I. lost a group while merely turning away his eye for a moment: Biela has found spots disappear while he looked at them: Krone has observed them to form within a single minute: Schwabe saw a penumbra increase from $1'\ 3''$ to $5'\ 2''$ in 24^h. Lubbock has seen spots with the naked eye, of which a telescope would show no trace next day. Capocci noticed the temporary reduction of an umbra, four times as large as the earth, to the dimensions of Europe, 'under his eyes:' an unfortunately vague expression, as the Académie des Sciences has remarked, but characteristic of that surprising fluctuation which must strike every observer. Dawes has alluded to the probability that the state of our own atmosphere may be concerned in many of these apparent variations.

The inquiry into their nature is very perplexing, from the absence of terrestrial analogies, the Sun evidently belonging to a wholly different and entirely unknown class of bodies. The theory of Professor Wilson of Glasgow, modified by Herschel I., has been very generally adopted, that

the spots are openings[1] in a blazing envelope or 'photosphere,'[2] through which we see, in the penumbra, a deeper and less brilliant region; at a still greater depth, in the interior of the umbra, a feeble luminosity, marking the 'cloudy stratum' of Dawes (or 'cirri' of Secchi); and below both these, in the nucleus, the non-luminous body of the Sun. This view rests on the perspective appearance of the penumbra, when near the limb, which usually[3] is more contracted on the side next the Sun's centre; and the depression has been supposed to be corroborated by several observations of actual notches in the limb.[4] Herschel I. thought these openings might be caused by invisible elastic vapour, rising from the dark body of the Sun, and expanding in its ascent: such is also the view of Secchi, Chacornac, and Dawes, who refer the brighter edges of the openings to their being 'folded back,' as it were, by the rush from beneath. On two occasions, in 1861, Schwabe found the limb faint and indistinct beyond spots

[1] According to Klein, this was first suggested by Schüler in 1770.

[2] Schröter used this very appropriate and now universally-admitted term as far back as 1792.

[3] De La Rue, Stewart, and Loewy have found, in longitude, 75 cases having the penumbra equal on both sides, 456 giving the perspective of depression, 74 the reverse; in latitude, 72 cases for, 17 against, depression, which they consider sufficiently established. It has been said, however (Klein, *Anleitung*, 60), that larger instruments and higher powers do not confirm the idea.

[4] An indentation on a globe will disappear in profile, unless its breadth and depth are considerable: hence such observations would be rare; they have been recorded by La Hire, 1703; Cassini, 1719; Herschel I., 1800; Dollond and others, 1846; Lowe, 1849; Newall, 1850, 1859; observers at Kew and Dessau, 1868; but some of these may have been due to inferiority in optical means. If the spots were masses suspended above the photosphere, as Kirchhoff and a few others still maintain, they would, as Howlett well observes, be *often seen* as notches in the limb.

recently entered. Herschel II. inclined to the idea that a transparent atmosphere above the luminous stratum may be subject near its equatorial regions, like that of the earth, to hurricanes, forcing their way downwards to the surface. Circular movements are occasionally traceable: they were noticed by Silberschlag a century ago; Elvins and Knobel observed them in 1867; and Dawes detected them in two nuclei, one rotating through 100° in 6^d, the other through 70° in 24^h. Secchi has also perceived, besides several cases of rotation, a spiral structure in the penumbræ and nuclei of certain spots. Something of the kind has likewise been twice delineated by Birt, and noticed by several other observers, especially Lohse in 1872; and, though Spörer thinks it deceptive, it deserves careful attention. The excentricity or lateral deficiency occasionally noticed in the penumbra seems to indicate an oblique direction of disturbance. Secchi has revived Wilson's idea, that the penumbræ may slope inwards: he calculates that their depth is about $\frac{1}{3}$ the semi-diameter of the earth, or upwards of 1,300 miles—a depression which the subsequent computations of Faye have extended through a space of from 2,000 to 3,800 miles. From the nature of the photosphere, we might conjecture that of the spots, were it not equally unknown. Dawes, Huggins, and Schwabe, like Herschel I., infer an irregular distribution of luminous clouds: Arago's polariscope experiments were thought to have shown that the light is that of flame, not of white-hot solid or fluid matter; but the result is questionable. Secchi and Henry have shown that the spots are relatively cool. Herschel II. deduced the partial removal of definite films, floating on a dark or transparent ocean, rather than the melting of mist or mutual dilution of gaseous media, and the analogy of the Aurora Borealis has also been alluded to by him and his father. At present,

however, the idea seems to be obtaining currency that the darkness results from the absorption of the light of the photosphere in traversing vapour below a certain degree of temperature, and that the spots are produced by descending currents of gaseous material which have become cooled from their propulsion into a higher region. It is known at least that an intimate connection exists between the number of spots and the number and magnitude of the upward currents which cause the prominences surrounding the solar limb. It does not fall within our province to treat of these marvellous appendages, at once beautiful in tint, fantastic in form, and astonishing in mutability. The spectroscope, through which alone they can be studied (excepting during a total solar eclipse), is very seldom attached to 'common telescopes;' and those inclined to pursue this most interesting branch of research would find far better guidance than could be given in these pages in Schellen's 'Spectrum Analysis' translated by Miss Lassell, Roscoe's 'Spectrum Analysis,' Secchi's 'Le Soleil,' or Schellen's enlarged German edition of it 'Die Sonne,' or Proctor's 'Spectroscope.'

In confirmation of the theory last referred to, it is observed that the prominences on the Sun's limb in the vicinity of spots appear to curl over towards them; but there is still much unexplained: the prominences occur in all latitudes, even in the neighbourhood of the poles; but the spots are chiefly confined, as we have seen, to much narrower limits: and on the whole we are far from any satisfactory knowledge of the processes by which they are formed and maintained; our interest, however, in the phænomena is increasing, since there is now more than a suspicion that they influence the whole dependent system. The extraordinary perseverance of Schwabe[1] has shown that the spots have regular maxima

[1] *The late* lamented President of the Astronomical Society, Mr.

and minima, with a period averaging about 10, or, according to Schmidt and Wolf (from a much more extended comparison),[1] 11·11 years; which corresponds so exactly with the period of all magnetic variations, that both, as well as auroræ and electrical earth-currents, are now ascribed to the same unknown power, and the spots are no longer objects of mere curiosity, but indications of a mighty force, one of the prime laws of the universe.

Johnson, thus refers to the presentation of their Gold Medal to this observer :—'It was not . . . . for any special difficulty attending the research, that your Council has thought fit to confer on M. Schwabe this highest tribute of the Society's applause. What they wish most emphatically to express is their admiration of the indomitable zeal and untiring energy which he has displayed in bringing that research to a successful issue. Twelve years, as I have said, he spent to satisfy himself—six more years to satisfy, and still thirteen more to convince, mankind. For thirty years never has the Sun exhibited his disc above the horizon of Dessau without being confronted by Schwabe's imperturbable telescope, and that appears to have happened on an average about 300 days a-year. So, supposing that he observed but once a-day, he has made 9,000 observations, in the course of which he discovered about 4,700 groups. This is, I believe, an instance of devoted persistence (if the word were not equivocal, I should say, pertinacity) unsurpassed in the annals of astronomy. The energy of one man has revealed a phænomenon that had eluded even the suspicion of astronomers for 200 years!'

[1] An abstract of Dr. Wolf's results may be found in *Memoirs of the Royal Astronomical Society*, vol. xliii., showing that though the average length between successive *maxima* is 11·11 years, a period of 16·1 years is found between those of 1788 and 1804, while only 7·3 years elapsed between those of 1829 and 1837. The intervals of remarkable auroral displays correspond fairly with those of sun-spot *maxima*, and Wolf finds evidence for a longer period,—56 years, in the latter; and that their increase is more rapid than their decrease, with a second subsidiary *maximum* a year or two after their greatest development.

The revelations of the spectroscope, which, according to Balfour Stewart, have indicated the existence of 23 terrestrial elements in the Sun, are among the most surprising of modern astronomical discoveries, and stand on evidence which seems incontrovertible;[1] but they still leave much to be investigated; much that we can never reasonably hope to explain.

Concurrent authorities have justified our assuming that the spots are at least depressions, if not openings; yet observations exist, looking another way; and it may be well to insert them from their curiosity, as well as their being seldom referred to. Dr. Long, who published a Treatise on Astronomy in 1764, states that he, 'many years since, while he was viewing the image of the Sun, cast through a telescope upon white paper, saw one roundish spot, by estimation not much less in diameter than our earth, break into two, which immediately receded from one another with a prodigious velocity.' Dr. Wollaston says: 'Once I saw, with a 12-inch reflector, a spot burst to pieces while I was looking at it. I could not expect such an event, and therefore cannot be certain of the exact particulars; but the appearance, as it struck me at the time, was like that of a piece of ice when dashed on a frozen pond, which breaks to pieces and slides on the surface in various directions. I was then a very young astronomer, but I think I may be sure of the fact.' It is also stated that Bayley, who sailed twice with Captain

[1] The probability resulting from one or two coincidences in the position of lines would of course be but slight, but it rises rapidly with the multiplication of comparisons. Kirchhoff says, that about 60 lines are common to the vapour of iron and the light of the photosphere, and the consequent chance in favour of its presence is more than 1,000,000,000,000,000,000 to one. Yet this is but one set *out of a com*bination of corresponding lines.

Cook, saw a spot split in two.[1] From such appearances, an observer, unacquainted with the ordinary theory, might easily have inferred the solidity, from the disruption, of the dark object. On chemical grounds, connected (but not as a necessary consequence) with spectrum analysis, Kirchhoff and Bunsen have deduced a constitution analogous to floating clouds; an opinion adopted by Donati and Spörer. Zöllner ascribes to them a scoriaceous character. Raschig (1816), Weiss (1864), Hallaschka, and Haag (1869), observed what they considered a passage of one spot over another.[2]

Notwithstanding their changeable nature, the larger spots are possessed of some permanency.[3] After describing straight lines about June 11 and Dec. 12,[4] but elliptical paths at other times, in consequence of the position of the Sun's equator towards our eye,[5] they go out of sight at the W. limb, and, if not dissipated, return at the E. edge after about $13\frac{3}{8}^{d}$ to run the same course. Some have thus persisted through many revolutions. In 1779, a large spot continued visible for 6 months, and in 1840 and 1841 Schwabe observed 18 returns (though not consecutive) of the same group: the most permanent, he says, are usually round, of moderate size, and not sharply defined. Carrington thinks there can be no question of their occasional reappearance in the same

[1] Some strange separations and oscillations of umbræ, recorded at Lawson's observatory in 1849, were probably due to the unsteadiness of our atmosphere; but a better observer, Robinson of Armagh, saw a luminous bridge shot across some thousands of miles of umbra in a few minutes.

[2] Schellen, *Spectrum Analysis*, 273.

[3] Howlett has also found some of the smaller and more isolated ones very persistent.

[4] So Herschel II., *Outlines of Astronomy*, § 390. But in the next paragraph they stand as July 12 and Dec. 11.

[5] Inclination 7° 15′, Carrington; 6° 57′, Spörer.

places; as indeed had been supposed by La Hire as far back as 1700; and this reduces within certain limits their proper motion, which was perceived at an early period by Schröter and others, and micrometrically established in a lateral direction by Challis in 1857. Carrington has subsequently made known his very interesting discovery that the period of rotation varies with the latitude; the backward drift of the photosphere in the higher latitudes causing a difference of more than 2 days between the respective periods derived from spots in latitudes ± 50°, and those situated near the equator; so that the period of rotation of a spot may be determined by its latitude, if unchanged: in this respect, however, it may exhibit slight deviation.[1] With these shifting landmarks, it is not surprising that the Sun's period of rotation should have been variously estimated. Laugier's value, $25^d\ 8^h\ 10^m$, was formerly adopted; Spörer has given $24^d\ 14^h\ 59^m$, Carrington $24^d\ 23^h\ 18^m\ 23^s$, for spots in latitude 15°. Possibly, as the latter suggests, the interior mass may revolve with greater speed. Relative displacement in groups would be an interesting study, requiring neither micrometer nor clock, only careful drawing. The application of photography to solar delineation, as at Kew and Ely, is not likely to be within the reach of our readers: it is, however, too important to be passed over in silence. Howlett

[1] Peters (1846) ascribed to all the spots a *set* towards the equator; Laugier, from it. Carrington's valuable results were the fruit of unwearied perseverance through 11 years in the use of a very simple apparatus, consisting only of cross wires in an equatorially mounted telescope, without driving-clock or micrometer. It is to be regretted that his work has not been continued by some possessor of a 'common telescope,' which, with the requisite command of time, would be quite sufficient. A full account of his method is given in Carrington's *Observations of Solar Spots* (1863)—often *to be met with* second-hand.

and several others have found that spots near the limb require a different focus from those in the centre; arising, no doubt, as Dawes says, from the effect on the retina of very different degrees of brightness.

2. The *Faculæ*, or bright streaks. Less obvious than the dark spots, and requiring more power, these are not difficult objects, and were detected by Galileo: they are to be looked for in the spot-bearing regions, but only near the limbs.[1] They are irregular, curved, and branching, considerably more luminous than their vicinity, but not, according to Secchi, than the centre of the Sun. He observed one in 1858, at least 60° in length. They are proved to be what they appear, ridges in the photosphere, by an observation of Dawes, who once saw a facula projecting above the limb as it turned across it into the other hemisphere, and at another time the luminous border of a large spot which had just entered, forming an irregular low ridge upon the limb: Secchi also has seen a similar appearance. We seldom, however, find them visible close to the limb, or far from it, as they are changed in the centre into bright tufts and specks; an effect, as Secchi has pointed out, of perspective, if their height much exceeds their breadth; or of the elevation of their crests above an absorbent atmosphere. Howlett sees them beautifully projected on a screen, and thus detects them in the centre of the disc. They are nearly as variable as the spots, and are probably connected with them, surrounding them usually near the limb, and sometimes as they cross the centre, attending their development, and succeeding their dissolution; as though they were temporary accumulations of the displaced matter of the photosphere. Secchi compares them to immense waves raised by the outburst of the spots, of which

[1] They were observed by Carrington and Noble nearer the centre than usual in 1870, a maximum spot-period.

they are commonly the harbingers. Schwabe thinks them rather more obvious when spots are few,[1] and suspects that one at least, consisting of 5 to 7 connected ovals, and enclosing occasionally a great group of spots, may be a permanent or recurring feature. The authors of 'Solar Physics' consider them (and probably the whole photosphere) as consisting of solid or liquid bodies suspended or slowly sinking in a gaseous medium. They find that on an average they follow the accompanying spots, and infer that they have probably been uplifted out of them, and have fallen behind from being thrown up into a more swiftly rotating region.

3. The *Mottled Surface.* An object-glass of only 2 inches will exhibit a curdled or marbled appearance over the whole disc, caused by the intermixture of spaces of different brightness. The earliest mention I have noticed of this mottling is during the solar eclipse, 1748, July 14 (O. S.), when it was clearly described by Mr. J. Short (the eminent optician ?), to whom it was quite new: since that time it has been a familiar object; and it must have been this coarser mottling which Schwabe described in 1831, as showing itself strongest in the spotted zones, like two freckled girdles round the Sun. Should this marbled appearance not be at once detected, a slight shaking of the image by tapping the telescope may render it perceptible. Increase of magnifying power, however, brings out a far more delicate mottling overspreading the coarser irregularity, and occasioned by the juxtaposition of minute patches of greater brightness on a greyer ground. This was first observed by Herschel I., and described in two very valuable but not perhaps sufficiently known papers on the Sun ('Phil. Trans.' 1795, 1801), in the former of which the whole solar surface is said to have 'the appearance of a

[1] He has since adopted an opposite opinion.—*Monthly Notices*, xxvii. 286.

mixture of small points of an unequal light,' and in the latter is described as 'studded with nodules,' which are also referred to a stratum of self-luminous clouds of unequal thickness, of which the higher and lower regions tend respectively to form faculæ and penumbræ. It has more recently been interpreted by Nasmyth (1861) as the interlacing of a multitude of lenticular masses resembling willow leaves in form, the length of each being ten times its breadth. Considerable discussion has arisen as to the point; but the supporters of this idea are few, and the prevalent opinion is that of Dawes, who had been familiar with the phænomenon since 1830; and found, from very careful examination of the photosphere, that it was composed of minute 'granules,' or luminous clouds, irregular in form and size, and separated by less brilliant interstices; thus agreeing precisely with the view given in 1792 by Herschel I. The less luminous interstices are frequently stippled with dusky or nearly black points, seldom circular and often arranged in rows. In the faculæ and round the penumbræ, where the photosphere appears to be heaped up or rolled together, these interstices usually disappear, and the compressed and elongated granules, like very slender faculæ, extend over the penumbra, and often project, like irregular thatch, on to the outer border of the umbra; or, many being joined together, cross the umbra and nucleus as luminous bridges. The grey interstices were thought by Herschel I. to be portions of a lower stratum; but, as he remarked, the depression must be very slight, since they are visible in extreme foreshortening towards the limb. This view is adopted by many of our best observers, including Fletcher, Lockyer, Huggins, and Knott; and is supported by O. Struve, Secchi, and Le Verrier. Huggins adds his impression, that the general surface on which the granules are strewed is itself 'corrugated into irregular ridges and

vales,' not unlike a stormy sea; and coincides with the idea of Herschel II. as to 'a luminous medium intermixed but not confounded with a transparent and non-luminous atmosphere.' In the use of a 13-inch achromatic of very fine definition, Langley has found that each of these granules is composed of a varying number, 3 to 10, of brilliant points (*his* granules), which on the whole occupy less than $\frac{1}{5}$ of the Sun, and are the chief source of its light. He thinks that they are the upper ends of elongated filaments, the length of which is seen in an inclined position in the penumbræ: and he finds evidence in the spots not only of cyclonic action, frequently right and left-handed whirls in juxtaposition, but also of horizontal currents. The same structure is also shown in some fine photographs by Janssen.

4. The *Transparent Atmosphere.* That this exists, and is of far greater proportionate extent than planetary atmospheres, is demonstrated in total eclipses by the red prominences which then surprise the spectators, and which may, as Janssen and Lockyer have discovered, be detected at any time by the spectroscope: but the presence, and the comparative shallowness, of an absorbent envelope forming its interior stratum is at once evident from the faintness of the limb compared with the centre of the disc. This was early remarked at Rome by Luca Valerio, called by Galileo the Archimedes of his time: it was denied by the inventor of the telescope, but may be easily perceived when the image is cast on paper; and its effect is evident in the Kew, and especially the Rutherfurd photographs.[1] By means of a doubly refracting prism,

[1] Arago's polariscope failed to exhibit this difference; it has been shown by the later observations of Schwabe, that it does not invariably exist, and that when it is not perceptible, there is also an absence of faculæ, 'scars,' and pores. Spörer, however, is disposed to refer such observations to dew or hoar-frost on the object-*glass.*

Secchi has found the limb not more luminous than the penumbræ of spots in the middle of the Sun—that is, deprived of about half the light;[1] and his previous discovery of a similar decrease of heat confirms the existence of such an absorbent stratum. Hence also may result the inferior distinctness of the solar limb as compared with that of the Moon in eclipses: a fact remarked by Airy, and exhibited by photography; and Secchi has observed that the occasional bad definition of the spots may be due to the solar atmosphere instead of our own. Some measures of his, and observations by Spörer, seem to indicate a refractive power in this atmosphere, producing an apparent displacement of the spots towards the limb.

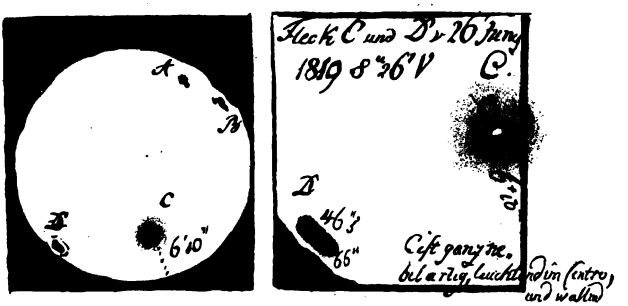
Something must be said of the Sun as a background for the exhibition of intervening bodies. Partial solar eclipses seldom gain much interest in the use of the telescope, excepting from the occasional projection of mountains on the Moon's limb. The total eclipse is so wonderful and so fugitive as to require special preparation, and is too rare in England to require notice here. The transits of Mercury will be found under the head of that planet: those of Venus are too uncommon and distant to be admitted in our limited space; the next visible in England not occurring till 1882, its successor not till 2004. Comets, from the endless diversity of their paths, must occasionally traverse the solar disc; and the opportunity of such a background would be most valuable for acquiring more information as to their nature. This actually took place, 1819, June 26; but it was not known till afterwards, when a controversy arose as to whether the

[1] He has subsequently reduced this to $\frac{1}{3}$ or $\frac{1}{4}$, and finds the limb of a very decided smoky red tint. Elger has seen a portion of the disc near the limb intensely brown, where large spots have disappeared.

stranger had been visible. Pastorff, of Buchholtz, near Frankfort, maintained that he had that day seen on the Sun a round dark nebulous spot with a bright point in the centre: Olbers and Schumacher thought there was no ground for supposing it to have been the comet; but, most fortunately, the original sketch of Pastorff, which is still in existence, and of which, through Sir J. Herschel's kindness, I have been enabled to give a copy (omitting only an attempt to show the mottled aspect), satisfactorily establishes the accuracy of that unique and most curious observation.

This astronomer has left three volumes of drawings of the solar spots, commencing just in time for our present purpose, as that in question is only the third from the beginning. According to his frequent practice, an enlarged view of the most remarkable spots is set beside one representing, in somewhat careless proportion, the whole disc. The singular contrast between the transparent nucleus and dusky coma, missed or obliterated in the general sketch, is especially delineated in the detailed one; and the whole aspect carefully described in the German annotation, 'C is quite hazy, luminous in the centre, and *boiling*' (atmospherically unsteady). On the following day is the confirmatory remark that D (going off the limb) and C had vanished. The care with which the strange spot was observed is evident from the micrometrical measure of its extent. Canon Stark, of Augsburg, also noticed a remarkable spot on that day: it was neither like an umbra nor a penumbra, was not well defined, and had no black depth in it; this was at $7\frac{1}{4}^{h}$ A.M.; at noon it was no longer visible.[1] In 1826, Gambart found

[1] These observations have been seriously questioned by Hind, as not corresponding, especially Pastorff's, with the calculated place of the comet: it has not, however, been thought necessary to omit them. Ranyard has found a drawing of a similar but smaller *object in* Pastorff, May 26, 1828. He calls it a 'brightly-shining



COMET OF 1819

IN TRANSIT OVER THE SUN

that a comet which he had discovered would be on the solar disc a little after its rising on November 18, and gave immediate warning to the astronomers of Europe; but the weather caused almost universal disappointment; only Gambart and Flaugergues had a view of the Sun, and neither of them could perceive a trace of the comet. If anything unusual should ever be noticed on the disc, it should be carefully watched; and should its rate of progress show that it is not an ordinary spot, its appearance ought to be most critically examined with various powers and screen-glasses, and information telegraphed instantly, where practicable, to some of our principal observatories.

But there is another reason for attention to anything of unwonted aspect on the Sun: it appears that opaque bodies, of unknown but most mysterious character, traverse it from time to time. The following details comprise a summary of the principal recorded instances; and the room allotted to them will, it is believed, be justified by the singularity of the subject:—

1761, June 6. Round black spot = $\frac{1}{4}$ ♀, traversing Sun during transit of ♀. Scheuten (probably the least reliable case).

1762, end of Feb. Round black spot, not visible next day: 'Might this have been a new planet?' Staudacher.

1762, Nov. 19, after sunrise. Large round black spot: left disc after traversing chord of 70°. Lichtenberg.

1764, beginning of May. Large round black spot, which seemed to have independent motion. Hofmann.

1784. Round spot, not found some hours afterwards. D'Angos, at Tarbes.

spot.' There was no trace of it on the preceding or following day. A dark body with concentric nebulous arcs around it appears in the photographs of the total eclipse, Dec. 1871, and has been suspected to be a large comet relieved on the background of the corona.

1798, Jan. 18. Black, well-defined, somewhat elliptical spot, about half way from centre to limb, in motion, and watched to its egress about 20^m afterwards. D'Angos. (The Chevalier's reputation for accuracy does not stand very high. Smyth tells us that, in commemoration of some strange mistakes, Baron de Zach 'was induced to term any egregious astronomical blunders—*Angosiades*;' and Encke went so far as to charge him with invention.)

1800, Mar. 29. Small black spot, almost without penumbra, increasing its distance from limb $18\frac{1}{4}'$ in 6^h. Fritsch at Quedlinburg; who was fond, however, of ascribing proper motions to solar spots.

1802, Feb. 7. Spot showing rapid and anomalous motion. Fritsch.

1802, Oct. 10. Spot moving $2'$ in 3^m, and not found after cloudy interval of 4^h. Fritsch.

The next instance is so well attested that it seems a pity to curtail it: it is thus given by Mr. Capel Lofft, of Ipswich, in a letter to the 'Monthly Magazine,' dated 1818, January 10. 'I saw it about 11 A.M.' (on January 6), 'with my own reflector, with a power of about 80; with an excellent Cassegrain reflector made by Crickmore of this town, with about 260; and with a reflector of Mr. Acton's, with about 170. It appeared, when I first saw it, somewhat about one-third from the eastern limb, subelliptic, small, uniformly opaque. About $2\frac{1}{2}$ hours, P.M., it appeared to Mr. Acton considerably advanced, and a little west of the Sun's centre; and I think it appeared then 6 or 8 seconds in diameter. I had been able to see no spot on the 4th, nor again on the 8th; and even on the 6th Mr. Crickmore could not see it a little before sunset, though the telescope already mentioned gave him every advantage. Its apparent path while visible seemed to *make a small* angle with the Sun's equator. Its state of

motion seemed inconsistent with that of the solar rotation, and both in figure, density, and regularity of path, it seemed utterly unlike floating scoria. In short, its progress over the Sun's disc seems to have exceeded that of Venus in transit. There are two instances, if not three, of comets seen in transit, and this phænomenon seems to have been one. I wish it may have been seen elsewhere.'

1819, Oct. 9. Well-defined round spot, about = ☿, not to be found again in the evening. Stark, canon of Augsburg, a regular meteorological observer.

1820, Feb. 12, $10\frac{3}{4}^{h}$. Spot unlike all the rest; well-defined, circular, orange-red, and surrounded by an atmosphere; crossed Sun in nearly 5^{h}. Steinheibel, a practised solar observer. Seen also by Stark at noon, as a singular, well-defined, circular, orange-gold spot, nearly twice the size of ☿, with circular atmosphere, which was not visible in the evening. (One of the most remarkable of these strange accounts, and at the same time one of the best attested; there seeming no reason to doubt that the two observations, though so similarly worded, were entirely distinct and independent.)

1821, Feb. 12. Sharply-defined circular spot. Steinheil.

1823, Oct. 23. A similar observation. Biela.

1826, July 31. Canon Stark.

1833. Pastorff saw a small round spot so frequently that he suspected its planetary nature: but he has not mentioned its rate of progress, and it was not noticed by others.[1]

1837, July 12. Very small and perfectly circular spot

[1] Wartmann has stated that, in 1834, '36, and '37, Pastorff saw little bodies form [qu. *pass*?] over the disc in comparatively short spaces of time. Pastorff's own records end in 1833. — *Monthly Notices*, xx. 67.

without a trace of penumbra, crossing in 6^h a considerable portion of the disc. De-Vico (Rome).

1839, Oct. 2. Perfectly round well-defined black spot advancing so rapidly that it would have crossed the disc in about 6^h. Decuppis (Rome).

1847, end of June or beginning of July. Perfectly circular black spot of unusual character on disc a little before sunset. Scott, City Chamberlain, near London, $4\frac{1}{2}$-in. achr. Wray, the optician, then at Whitby, watched the same spot, about 6″ in diameter, with $4\frac{1}{2}$-in. refl. for 40^m through 5′ of arc: clouds hindered sight of egress in about 10^m at W. limb.

1849, March 12. Small circular black spot watched in progress for nearly half-an-hour. Sidebotham and Lowe (Manchester).

1853, Aug. 30. Spot between 10″ and 20″. Jännicke.

1857, Sept. 12. 1^h P.M. Roundish spot about 5′ from N. limb, not much smaller than ☿. 13, cloudy. 14, that spot had gone, others remaining visible. Ohrt.

1858, Aug. 1. Circular opaque body moving from E. to W. watched from 4^h to 5^h 30^m. Wilson (Manchester).

1859, Mar. 26. Small dark body about 3″, crossing part of disc to egress. Lescarbault. (The celebrated pseudo-Vulcan. Liais, in Brazil, saw nothing at the same hour.) [1]

1860, Jan. 29. Round black spot like ☿ in transit, clearly defined through fog on lowest part of Sun soon after 8^h, and moving slowly till egress about 9^h 30^m. Russell and 3 others.

1862, Mar. 20, A.M. Sharp round black spot of about 7″; watched, but to disadvantage, in progress for 20^m. Lummis and a friend (Manchester).

[1] The question of intra-Mercurial planets has been revived and extended by the observations of Watson and Swift, in America, *during the* total eclipse of 1878, but requires further investigation.

1863, Aug. 30. An observation by Spörer.

1864, Feb. 12, 8^h 20^m. Spot of 8″ crossed disc at a rate between those of ☿ and ♀. Beswick (N. York). Doubtful.

1865, May 8, 9^h 28^m. Round black point moving across disc: oval just at exit, 48^m afterwards. Coumbary (Constantinople).

1876, April 4, P.M. Round black spot smaller than ☿, 2″·75 from E. limb, where sun-spots are fore-shortened. Clouds interfered; but it had not been there in the morning and was gone the next day. Weber, an old observer.

Whatever allowance may be made for mistaken impressions in some of these cases, enough remains to prove the reality of these strange occurrences. With so much opacity, it is singular that they should never have been seen by reflected light (except, as has been suggested, in the possible case of the supposed satellite of Venus); and that all of them should be interior to the orbit of the Earth.[1]

It may never be granted to our readers to witness such a wonderful outburst of light in front of the Sun as was observed by Carrington and Hodgson, 1859, Sept. 1; and repeated, according to Brodie, on a minor scale, 1864, Oct. 1. But should any of them be so fortunate, the propriety need scarcely be mentioned of the greatest care in the record, and readiness in the publication, of such an event.

[1] An observation by Messier, 1777, June 17, has been referred to, but the original points rather to the intervention of drops of rain or hail-stones. The dark bodies seen crossing the Sun by Capocci and others at Naples, 1845, May 11, 12, 13, were evidently, as Dawes has pointed out, light bodies, such as seeds, floating in our own atmosphere. On three occasions—1847, Oct. 11; 1849, Oct. 14; 1850, Feb. 28—Schmidt witnessed the transit of black bodies, the two latter of 15″ and 30″, and from W. to E., which he believed not to be birds or insects. But the rapidity of their movement transfers them to another class. They may have been meteors.

MERCURY.

THIS planet, though at times readily visible to the naked eye, is but seldom seen from its nearness to the Sun, and often lies too near the horizon for the telescope. A well-adjusted equatorial stand will find it by day, but its small diameter of about 3,060 miles subtends at a mean only 7·5″; and it was sometimes missed, as well as once noticed extremely faint, even by the experienced Schröter.

Ordinary observers will not see much, where professed astronomers have usually found little; but, as these pages may possibly fall into the hands of some whose advantages or enterprise may lead them to attack a neglected object, the following points may be specified:—

1. The *Phases.* These will be easily seen, and are only remarkable because the breadth of the enlightened part has been sometimes found less than it should have been from calculation. Schröter noticed this: Beer and Mädler confirm it; but their explanation of a dense atmosphere enfeebling the terminator, or boundary of light and darkness, is inadequate, as their observation was before sunrise, when even the dullest part of the disc would be very luminous. See this again in Venus.

2. The *Mountains.* At the close of the last and beginning of this century, Schröter, of Lilienthal in Hanover, a most diligent observer, and his assistant Harding, obtained what they deemed sufficient evidence of a mountainous surface in the alternate blunting of the horns,[1] some minute projections from the limb, and an irregular curve of the

[1] Noble also has suspected this (1864) as to S. horn, and Burton; and both saw an ill-defined terminator. Franks also has seen *(1877) the S. cusp* blunted.

terminator; they gave the inferred elevations a height of nearly 11 miles.

3. The *Atmosphere.* The decrease of light towards the terminator, and the occasional presence of dark streaks and spots, indicated to the same astronomers a vaporous envelope, where they even imagined traces of the action of winds. From a combination of their observations Bessel deduced a rotation in $24^h\ 0^m\ 53^s$ on an axis inclined about 70° to the ecliptic of Mercury. A bright spot with faint lines diverging from it, NE. and S., was seen by Prince a little S. of the centre, in unusually clear air, 1867, June 11; Birmingham was pretty certain that there was a large white spot near E. limb, 1870, March 13; and Vogel at Bothkamp observed spots, 1871, April 14 and 22. In De La Rue's Newtonian, 10 f. focus, 13 in. aperture, constructed by himself, and now at Oxford, the planet has a rosy tinge, noticed also by Burton, and once by Harding; Franks, however, sees it very white. Secchi has remarked that the disc is always very ill-terminated, and very faint at the edges, but Burton's admirable silvered specula give a sharply defined limb. Venus in the same field appeared to Nasmyth fully twice as reflective as Mercury.

Transits of Mercury are comparatively frequent; one will be visible in Europe, 1881, Nov. 7; others in 1891 and 1894. The planet breaks in upon the Sun as a dark notch, sometimes preceded, it is said, by a penumbral shade; but the earliest impression will be missed, unless the exact point of ingress is known, and kept central in the field. As it advances, the part of Mercury not yet entered may become visible by being projected upon the 'corona,' which is so conspicuous in total solar eclipses, and has been known to relieve dark bodies in front of it, such as an inferior planet, or even a portion of the Moon. (Pratt, 1873.) On finally

entering the Sun, or beginning to leave it, the planet has been seen lengthened towards the limb from irradiation: fully on the disc, where Mercury appears intensely black, some astronomers have given it a slight dusky border, others a narrow luminous ring: both, probably, deceptions from the violent contrast and the fatigue of the eye,[1] especially as others have remarked nothing of the kind. A similar explanation may be applied to a whitish or grey spot on the dark planet, seen by Wurzelbauer, 1697; Schröter, Harding, and Kohler, 1799; Fritsch and others, 1802; Moll and his assistants, 1832 (when Harding *clearly* distinguished *two* spots, and Gruithuisen suspected one); and recognised in England and America, 1848, and by Huggins and Elger, 1868, when Browning perceived *two* spots again. In 1878 also a bright speck was noticed by several English and Belgian observers (in one case, *two* specks), though others entirely failed to detect it; and every attempt to recognise it in America was unsuccessful. No terrestrial analogy will explain a luminosity thus visible close to the splendour of the Sun; and it seems natural to refer it to the exhausted state of the retina: an artificial disc, however, subsequently tried by Huggins, showed nothing of the kind. And everything that is seen, however improbable, should always be recorded: an opposite procedure would have effectually precluded many an important discovery. We may remark that Schröter and Harding ascribed to these spots a motion corresponding with the rotation which they subsequently inferred from other indications.[2]

[1] Pratt, however, in 1868, saw the 'halo' finely by projection in a darkened room.

[2] A similar phænomenon was observed on Venus in transit in 1761 (*Append. ad Ephem. Astron.* 1766, 62); and by some observers *in 1874.*

VENUS.

Fairest of stars, last in the train of night,
If better thou belong not to the dawn,
Sure pledge of day, that crown'st the smiling morn
With thy bright circlet, praise HIM in thy sphere.
MILTON.

THE most beautiful of all the heavenly bodies to the unaided eye is often a source of disappointment in the telescope. For the most part it resists all questioning beyond that of Galileo, to whom its phases revealed the confirmation of the Copernican theory; an important discovery, which he involved for a season in the following ingenious Latin transposition :—

Hæc immatura à me jam frustra leguntur, o. y.

the letters in their original order forming the words

Cynthiæ figuras æmulatur mater amorum.

Observers in general will subscribe to the experience of Herschel II., who says it is the most difficult of all the planets to define with telescopes. 'The intense lustre of its illuminated part dazzles the sight, and exaggerates every imperfection of the telescope: yet we see clearly that its surface is not mottled over with permanent spots like the Moon; we notice in it neither mountains nor shadows, but a uniform brightness, in which sometimes we may indeed fancy, or perhaps more than fancy, brighter or obscurer portions, but can seldom or never rest fully satisfied of the fact;' and he infers, like his father, and Huygens long before, that 'we do not see, as in the Moon, the real surface of these planets' (Venus and Mercury) 'but only their atmospheres, much loaded with clouds, and which may serve to mitigate the otherwise

intense glare of their sunshine.'[1] Notwithstanding, however, the authority of this opinion, perseverance has of late years rendered it doubtful: moderate-sized instruments have proved of service: and the silvered reflector, from its colourless image, is here greatly superior to the achromatic. The following are the chief points to be noticed:—

1. The *Phases*. With a mean diameter of 18″·8, these are of course easily seen, and very beautiful, excepting the dull gibbous form in the *superior* or farther part of the orbit, where the disc is also small; near the greatest elongation from the Sun towards the E. when she is an evening, or W. when a morning star, Venus puts on a beautiful shape—that of the moon in quadrature; between these points in the *inferior* or nearer part of the orbit, she is a most elegant crescent, larger, sharper, and thinner in proportion as she is nearer really to the Earth and apparently to the Sun. This crescent has been seen even with the naked eye in the sky of Chile,[2] and with a dark glass in Persia, and a very small telescope will show it. When quite slender it should not be looked for after sunset or before sunrise, as it lies too low in the vapour; but an equatorial stand will find it in the middle of the day—an exquisite object; and thus, or in a transit instrument, it has been many times traced as a mere curved thread extremely near the Sun.[3] Ordinary observers may succeed without an equatorial mounting in seeing it a very

[1] Chacornac was of the same opinion, from the absence of polarisation in the light of Venus. His apparatus showed her brightness to be 10 times greater than that of the most luminous parts of the Moon. The reduction of her light to $\frac{1}{2000}$ perceptibly diminished the image from removal of irradiation. Jupiter the same.

[2] Theodore Parker saw it in America when 12 years old, and ignorant of its existence, and when no one else could perceive it.

[3] Dawes considers that, with due precaution, Venus might be *seen in her* upper conjunction within 1′ of the Sun's limb.

delicate crescent soon after it has passed its inferior conjunction, by watching for its earliest appearance

Under the opening eyelids of the morn,

setting the finder, or the telescope with the lowest power, upon it, and following it at intervals sufficient to keep it in the field, till it has cleared the vapours of the horizon; in this way it may be readily viewed for hours. In fact, the planet is best seen for many purposes in the day-time; its light, unpleasantly dazzling in a dark sky, so as to bear a screen-glass, is subdued by day to a beautiful pearly lustre. Nor is it very difficult to find. For some time about its greatest brightness, at 40° from the Sun in the inferior part of the orbit, it not merely casts a shade by night, but is visible to the naked eye at noon-day: if its position is pretty well known, a little careful steady gazing will bring it out as an intense white point, when in good air it will be a charming telescopic object. At other seasons, a little hand-telescope with a large field will show it much sooner in the evening or later in the morning than might have been expected. Like that of Mercury, the phasis often disagrees with calculation; at its greatest elongations it ought to be exactly 'dichotomised' as a half-moon; but in August, 1793, Schröter found the terminator slightly concave in that position, and not straight till 8 days afterwards; and Beer and Mädler fully confirmed this by many observations in 1836, proving that the apparent 'half-moon' takes place 6 days earlier or later than the computed, according to the direction of the planet's motion. They found also that there is a similar defect in the breadth of the crescent-phasis. Neither their explanation of this, through the shadows of mountains, nor Schröter's, through the fading of light towards the terminator, is satisfactory as far as night observations are con-

cerned. In 1839 De-Vico and his assistants at Rome found a similar discrepancy of about 3 days. This curious phænomenon is so easily seen, that I perceived it with an inferior fluid achromatic, on Barlow's plan, 1833, March 6, before I knew that it had been noticed by others.

2. The *Mountainous Surface.* La Hire, in 1700, with an old 16 f. refractor, power 90, professed to have seen on several occasions in the crescent, when very narrow, 'des inegalitez beaucoup plus considerables que celles de la Lune;' and Briga not only described an indented terminator, but unjustifiably altered Cassini's figures accordingly. Fontana is also stated to have perceived it in earlier days. But Schröter's observations at the end of the last century are far more trustworthy. With several fine reflectors and a very good achromatic, he and others found the boundary sometimes slightly jagged, sometimes irregular in curvature, so as to vary the relative thickness of the horns; and these would occasionally pass through such changes as to show a rotation in $23^h\ 21^m\ 8^s$. At the quadrature, the N. cusp would frequently project, while the S. was blunted, with sometimes a minute point cut off from it by a narrow black line, the shadow apparently of a lofty ridge; some of these mountains Schröter supposed to be 27 or 28 miles high, but of course with great uncertainty. Herschel I. attacked these discoveries in the 'Philosophical Transactions' for 1793, in what Arago justly terms 'une critique fort vive, et, en apparence du moins, quelque peu passionnée.' Schröter calmly and satisfactorily vindicated himself through the same medium in 1795; and Beer and Mädler, in 1833 and 1836, have fully established his accuracy as to an irregularly curved terminator, causing great and rapid changes in the shape of the cusps. They also saw an occasional bending off of the S. *horn, corresponding* with Schröter's flattening of the limb

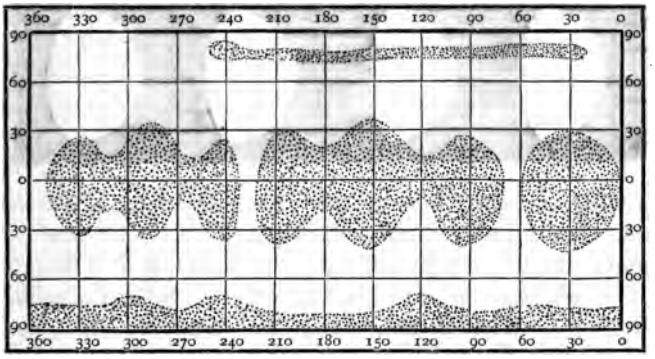
in that direction,[1] as Langdon has done at the other cusp. Gruithuisen in 1847 saw the S. horn blunted. Fritsch, in 1799 and 1801, witnessed several of these appearances with small telescopes. Gruithuisen and Pastorff have drawn an indented terminator; Flaugergues and Valz noticed its irregularity, but deny its changes. Breen, with the great Northumberland telescope at Cambridge, of 19½ f. focus, and 11½ in. aperture, has often seen the unequal curve of the terminator, and the blunted S. horn, and so have several recent observers: either cusp being at times blunted, or nearly or quite cut off. Pratt especially with a fine 8¼ in. 'With' mirror has fully confirmed Schröter's projections and indentations on the terminator. Safarik has also seen them, 1868; and in 1876 Baron van Ertborn repeatedly observed a bright point detached from the S. horn. But the most curious observations are those made by De-Vico and his assistants at Rome, in April and May 1841. An achromatic by Cauchoix, 6¼ in. aperture, with powers sometimes up to 1,128, enabled them to trace the approach towards the terminator, night after night, of a valley surrounded by mountains like a lunar crater, 4″·5 in diameter. The crescent was narrow, and near the N. horn they first saw an oblong black spot, which afterwards was bordered with stronger light, in the sequel encroached with half its ring upon the dark side, and ultimately formed a black notch between two bright projections, giving the appearance of a triply-pointed horn; a longer black streak was seen near the other cusp at the same time. Gruithuisen and Pastorff seem to have noticed

[1] It is a pity that the figures in their 'Beiträge' are so bad. Schröter's, though not good, are more intelligible. The Roman observers also have noticed this strange temporary flattening of the circular limb near the S. horn, and consider it a profile view of one of the large grey spots, which, if so, must be deeply depressed.

in part the same irregularity. Secchi, in 1857, with the $9\frac{6}{10}$ in. Merz achr., when the crescent was only $0''.4$ broad, observed it to be still further contracted in one part. Safarik and Lyman have seen two contractions; Buckingham has found it when very thin not merely irregular, but interrupted at 3 points; and Arcimis at Cadiz saw an indentation at the S. horn in 1876.

3. The *Spots*. These have occasioned much controversy, from their indistinctness, which is such that the Virgilian 'aut videt, aut vidisse putat' is often the observer's conclusion. There have been, however, many exceptions. In 1645 Fontana detected a dark spot; in 1666 and 1667 Domenico Cassini, at Bologna, repeatedly saw one bright and several dusky spots, the former giving a rotation in $23^h\ 21^m$; subsequently, in the air of France, he never could recover them, nor were J. J. Cassini or Maraldi at Paris more successful afterwards. In 1726 and 1727 Bianchini, at Rome, observed spots many times with a 66 f. refractor, aperture a little more than $2\frac{1}{2}$ in., power 112, like the 'seas' in the Moon to the naked eye, though less distinct; and not till after sunset, from want of light in his glass. His figures show them surrounding the equator of Venus, forming, as it were, three oceans—one tolerably circular, the others much lengthened, and each of the latter subdivided into three portions connected by narrower openings; besides two spots, one occupying the S. polar region, the other forming a horse-shoe round the N. pole. He did his work well, but, for want of *sky-room*, did not perceive the rapid motion of the spots, and gave a wrong rotation of $24^d\ 8^h$. A copy of this diagram is here given which the student may easily transfer to a small globe. Schröter and Herschel I., half a century later, with much finer instruments, but in less *pellucid* skies, could only make out through many years a

few faint markings, with suspicions of motion. Bode saw some dark spots in 1788: at last, 1801, Aug. 29, Schröter detected a dim oblique dusky streak, like one on Mercury, giving a rotation in about 24^h. Several other astronomers had occasional glimpses of darker shadowings; Gruithuisen perceived repeatedly long vertical shades, and minute brilliant round specks, and Schumacher a dusky spot in the twilight, which in half an hour was lost in increasing glare; others, visible with a small telescope, he found effaced in a larger one—a caution for future observers. Lamont failed entirely with an 11 in. achr. at Munich in 1836: but more



effective results were obtained at Rome, 1839–1841, by De-Vico, who had been instigated by Schumacher to verify Bianchini's assertions in the same atmosphere. He used the Cauchoix achromatic chiefly by day, since in a dark sky the glare overpowered the spots so much as to render the micrometer useless, and account for Bianchini's erroneous rotation: the drawings of the latter were, however, found, save in the omission of one small spot, remarkably exact. Of 6 observers, the most successful in seeing these faint clouds were those who had most difficulty in catching very

minute companions of large stars;[1] but all agreed in the figures, and witnessed a progression, giving a rotation in $23^h\ 21^m\ 22^s$ on an axis greatly inclined, though less so than Bianchini had supposed. They have given no less than 145 delineations; many of these are very coarsely executed, but, as they are little known in England, copies of a few of the more characteristic are given here. Of late these spots, invisible at Greenwich and to several of our first observers, have been recognised by others—De La Rue, Huggins, Worthington with a 13 in. mirror, Seabroke with the $8\frac{1}{4}$ in.

achr. belonging to Dawes, Terby, Denning, Safarik, Baron van Ertborn, and others, and described as bright patches and specks, and cloudy and crater-like markings of different forms and sizes; according to Ormesher, much like the spots of Mars. With describes the disc (April 6, 1868) as marbled or veined all over, and on the same occasion per-

[1] De-Vico assigns no reason, but it seems obvious enough, and worthy of notice. A very sensitive eye, which would detect the spots more readily, would be more easily overpowered by the light of a brilliant star, so as to miss a very minute one in its neighbourhood. There is abundant industry in these Roman observations: Palomba, the assistant, made 11,800 measures in 1839, of which 10,000 were employed in determining the rotation. But De-Vico's style wants explicitness, and there are strange traces of inexperience or inattention in the Jesuit College, rendering the memoirs of that date far less satisfactory than those of the succeeding and now to be lamented Director, Secchi.

ceived, with a 12¼ in. unsilvered mirror, a small bright projection on the circular limb,[1] about 40° from S. cusp: this was confirmed by Key, at about 36°, April 12 and subsequent days, with granulations towards a terminator more deeply serrated than that of the Moon: March 15, Browning had seen a bright patch of some extent 80° from that cusp, so luminous as to show projection like the snow on Mars. Could we but see these features more readily, what an interesting object would this lovely planet become, especially as in point of size it is the only companion to the Earth in the whole system![2] And the possessors of even common telescopes need not despair, though their chances may not be great: at Rome the spots have been seen even with a little telescope of 2 in. aperture, and the following recital shows that the chief difficulty lies in our own atmosphere; it is so curious that it must be given entire from the 'Philosophical Transactions':—'January 23, 1749–50, there was a splendid Aurora Borealis. About 6^{h} P.M., the Rev. Dr. Miles, at Tooting, had been viewing Jupiter and Venus, and showing them to some friends, with one of Short's reflectors, greatest power 200, when a small red cloud of the Aurora appeared, rising up from the SW. (as one of a deeper red had done before), which proceeded in a line with the planets, and soon surrounded both. Venus appearing still in full lustre, he viewed her again with the telescope, without altering the focus, and saw her much more distinctly than ever he had done upon any occasion. All his friends were of the same opinion as to the sight they had of her on that occasion. They all saw her spots plain, resembling those in the Moon, which he had never seen before, and this while the cloud seemed to surround it as

[1] Compare Schröter and Harding on *Mercury*, p. 46.

[2] Diameter, 7,850 miles.

much as ever; but whether the vapour might be rarer nearer the planet, no judgment could be made, because of her too powerful light.' In curious accordance with this, Langdon saw the irregularity of the terminator beautifully through an Aurora in 1873.

4. The *Atmosphere.* The bright border noticed by some observers as attending the circular limb may be a deception; and so probably were the polar snows which Gruithuisen imagined that he frequently saw; but there is very sufficient proof of the existence of a vaporous envelope. Schröter's dusky belt, already mentioned, indicates it.[1] He has ascribed to it the great decrease of light towards the terminator and cusps; and he and Herschel I. agreed as to the extension of the horns beyond a semicircle, which may be due in part to the penumbra, or additional daylight caused by the Sun's not being a point but a great disc, but more to refraction through an atmosphere. Schröter also perceived in 1790 a faint gleam along the limb beyond the horns, a true twilight produced by an atmosphere which must be denser than our own. In May 1849, Mädler at Dorpat found the horns projecting to 200° and even to 240°, showing a refraction about $\frac{1}{6}$ stronger than ours; and Lyman with a 9 in. achr. in America obtained a similar result: but from the calculation of Neison, who detected an error in the formulæ they employed, the true density comes out 1·892, or nearly twice as great as that of our atmosphere. From this cause Cassini in 1692, and Drew in 1854, found the crescent too broad near the conjunction. Secchi, in 1857, saw in that position the cusps much prolonged, and the twilight extending 19½°, even through our strongly

[1] Similar ones have been detected by Buffham, and a long, narrow line, possibly atmospherical, by De La Rue and Lord Rosse in *the great* Melbourne Cassegrain reflector.

illuminated atmosphere. Noble has seen the whole disc so bordered in almost every inferior conjunction; it had been recorded in the transit of 1769; and in 1864 and 1866, and at the recent transit, in common with several other observers, Lyman found the delicate ring complete, and considers that it will always be so within 1° 50′ from the Sun's centre; a segment only, of an extent proportioned to the distance, being visible beyond that limit. When entering the Sun in 1875, this light was especially conspicuous in one spot. Tacchini considers that this atmosphere contains traces of aqueous vapour.

5. The *Phosphorescence of the Dark Side.* This truly unaccountable appearance [1] is remarkably well attested; though it is but fair to state that it has been questioned by several good observers, even Dawes himself. It was noticed as far back as 1715, in the 'Astro-Theology' of Derham, who says that 'this sphæricity, or rotundity, is manifest in our Moon, yea and in Venus too, in whose greatest Falcations the dark part of their Globes may be perceived, exhibiting themselves under the appearance of a dull, and rusty colour.' 1721, June 7, Kirch, junior, believed that he saw it, the crescent being then extremely narrow; and again, with two others, 1726, Mar. 8, Herschel I. perceived traces of it. In 1806 it displayed itself beautifully to Harding three times (once with a companion), and to Schröter once, within five weeks. Pastorff also witnessed it twice. Guthrie and others noticed it in 1842, with small reflectors, in Scotland; Purchas, at Ross, in England; De-Vico and Palomba, many

[1] Arago's 'negative visibility' is but a perplexing attempt at solution. The faint illumination which renders some of our terrestrial nights lighter than others, remarked by Schröter, Arago, and, I think, by myself, scarcely affords an adequate comparison. Humboldt gives a striking instance, *Cosmos*, I., 131 (Bohn).

times, in Italy. Berry at Liverpool saw it in 1862 with no previous recollection of its visibility: it was remarked in that year, and especially in 1863, by many observers in England, and by one in 1865, as well as by four at Leipzig with the $8\frac{1}{2}$ in. achromatic. To these we may add Petty, 1868; Winnecke, 1871, Nov. 6; Elger, Erck, 1873; Banks, Grover, Arcimis, 1876; Mills, 1878. On Jan. 31 of that year, after having many times looked for it in vain in former years, I saw it, without specially thinking about it, with powers of about 90 and 212 on my 9·38 in. mirror, coming out at intervals rather paler and browner than the twilight sky, and equally visible when the bright crescent was hidden by a field-bar. Strange to say, it has been seen even in the day-time, by Andreas Mayer, 1759, Oct. 20, through merely a transit instrument, 44^m after noon: 'etsi pars lucida Veneris tenuis admodum erat, nihilominus integer discus apparuit, instar lunæ crescentis, quæ acceptum a terrâ lumen reflectit:' and Winnecke records a similar observation, though very faint, 1871, Sept. 25, a little before noon.[1]

[1] Langdon and several others perceived it by day a little before inferior conjunction, 1870, Feb. 5; but this, as well as some other instances, may have been merely the atmospheric ring of Lyman and Noble; and such appears to have been the case in some day-observations of Baron van Ertborn in 1876. A curious observation of my wife's may be cited here, made June 30, 1880, $7^h\ 30^m$ A.M., between the Lago Maggiore and Domo d'Ossola. The waning Moon, $21\frac{1}{2}^h$ past Last Quarter, was still at some height in W., but pale in the strong sunshine, when she noticed that the circle appeared complete, the dark side being smaller than the bright, of a more lilac tint than the deep blue Italian sky, and irregularly shaded, being brighter towards the SW. limb, as it would be, though she was not in the least aware of it. The phænomenon was confirmed to her by a good binocular glass; but neither I nor her servant could perceive it. She was not thinking at the time of the *lumière cendrée*, and *still less of the dark side* of Venus.

Von Hahn also says he made it out repeatedly, by day as well as by night, and with several instruments; he was, however, an inferior observer. Gruithuisen saw it once at sunrise; Mad. Safarik in a broad crescent, 1871, Aug. 9, 11^h A.M.; Browning many times, 1870, Feb. and Mar. with $10\frac{1}{4}$ in. silv. mirror, very distinct, brighter than the bright twilight of 5^h P.M., and even when gibbous Baron van Ertborn saw it in 1876. The dark side is often too small in proportion (as I saw it), like that of the crescent Moon to the naked eye; and from the same cause,—the irradiation of the luminous part; it is sometimes described as grey, sometimes reddish. It would be well worth looking for when the crescent is narrow, but Venus should have high N. latitude to clear the vapours of the horizon: the bright part should be put behind a bar in the field; and it should be noted whether the dark side is lighter or darker than the background. Noble has repeatedly seen the latter, projected, perhaps, on the solar corona.

6. The *Satellite*. This is an astronomical enigma. It is not easy to set aside the evidence of its occasional appearance; but it is more difficult to understand why, if it exists, it is so seldom visible, for the diameter ascribed to it is about $\frac{1}{4}$ that of Venus. Cassini saw it in 1672 and 1686; Short in 1740;[1] Mayer in 1759; Montaigne in 1791; Rödkier, Horrebow, and three others, at Copenhagen, and Montbarron, at Auxerre, in 1764.[2] The Abbat Hell maintains that all these were images formed by reflection in the eye-piece, in which way he could produce a satellite at will. This explanation would account for most of the observations, but not Short's, who, by using two telescopes, and at least four eye-pieces, during

[1] The air was then so clear that two darkish spots were visible.

[2] Most of the observations have been discussed by Lambert in a special memoir, *Astron. Jahrbuch*, 1777.

an hour, rendered the Abbat's conditions for the illusion almost impossible. Scheuten imagined that he saw it during the transit of 1761. Humboldt classes it with the 'myths of an uncritical age.' Smyth inclines to an opposite opinion. Hind considers it 'a question of great interest,' and says it 'must remain open for future decision.'

Mädler tells a strange story about a number of brushes of light diverging from the circular side of the crescent Venus, lasting as long as the planet could be seen that evening, and remaining unaffected by any turning round or change of the eye-piece. He attempts no explanation, but thinks it could not have been an optical illusion. This is certainly *possible*; but it is an instructive instance of the oversights which may be incidental even to great philosophers, that it never seems to have occurred to him to try another telescope.

THE MOON.

(Abbreviations :—Schr., *Schröter.*—G., *Gruithuisen.*—L., *Lohrmann.*—B. & M., *Beer*[1] *& Mädler.*—Ne., *Neison.*—Schm., *Schmidt.*)

THE comparatively small distance of our satellite, 240,000 miles,[2] renders it the easiest of telescopic objects. Its shadowed and irregular surface, visible to the naked eye,[3] is well brought out even with a low magnifier; hence Galileo

[1] This name is retained, as originally associated with the work, which, however, is known to have been chiefly executed by his colleague.

[2] More accurately 238,840, varying, from its elliptical orbit, between 252,972 and 221,614 miles.

[3] Klein observes that an immense amount of detail may be made out in the Full Moon with the naked eye, especially if the light of a flame enters it at the same time.

readily comprehended the nature of what his new and imperfect invention disclosed to him, and the smallest instrument will show that freckled aspect, arising from numberless craters, which he compared to the eyes in a peacock's tail. Many a pleasant hour awaits the student in these wonderful regions; only let him not expect that what he sees so plainly will be equally intelligible, excepting in its unquestionable relief from the effect of light and shade. Greatly overstrained ideas, as to the possibility of making out the minute details of the surface, have been entertained, not much more reasonable than those of the islanders of Teneriffe, whose simplicity led them to imagine that the telescope of Piazzi Smyth would show their favourite goats in our satellite; a very little consideration, however, will detect the absurdity of such anticipations. The first 'Moon Committee' of the British Association recommended a power of 1,000; few indeed are the instruments or the nights that will bear it; but when employed, what will be the result? Since increase of magnifying is equivalent to decrease of distance, we shall see the Moon as large (though not as distinct) as if it were 240 miles off, and any one can judge what could be made of the grandest building on earth at that distance: very small objects, it is true, are discoverable there with the finest instruments, possibly 150 feet broad, or from their shadows one third as much in height; but their nature remains unknown. Much difficulty, too, arises from the want of terrestrial analogies. It may be reasonably supposed that Venus or Mars, at the like distance, might be far more intelligible. We should certainly not find them mere transcripts of our own planet, for the conditions of existence as to temperature and air, if not in other respects, are very different, and, as Schr. often remarks, variety of detail in unity of design is characteristic of creation; but we might have a fair chance of understanding something

of what we saw. It is quite otherwise with the Moon. It is, in B. and M.'s words, no copy of the Earth; the absence of seas, rivers, atmosphere, vapours, and seasons [1] bespeaks the absence of 'the busy haunts of men;' indeed of all terrestrial vitality, unless it be that of an insect or reptile. Whatever may be the features of the averted hemisphere, on which, as G. and Hansen have suggested, other relations may exist, we perceive on this side a mere alternation of level deserts and craggy wildernesses. The hope which cheered on G. and others, of discovering the footsteps of human intelligence, must be abandoned.[2] If it should be thought probable, as it very reasonably may, that the lunar surface is habitable in some way of its own, we have reason to suppose that, where the conditions of life are so extremely dissimilar, its traces would be as undecipherable by our experience as a brief inscription in a character utterly unknown. We ought not, in fact, to be surprised at such a difference between bodies belonging to distinct classes: it would have been unreasonable to have looked for a duplicate of a primary planet in its attendant. Waiving, then, any disappointment from this cause, we shall find the Moon a wonderful object of study. It presents to us a surface convulsed, upturned, and desolated by forces of the highest activity, the

[1] This assertion must be limited to the subject in hand. It is not intended to deny the possibility of some kind of atmosphere, or fluid; and a trifling change of seasons would result from the slight inclination of the lunar axis (1° 32′ 9″).

[2] The existence of many natural wonders on our own globe—for example, the *cañons*, or river-gorges, of NW. America, one of which has a length of 550 miles, an extreme depth of 7,000 ft., and a closest contraction of 100 ft.; or the obelisk of limestone, near Lanslebourg, 360 ft. high with a base of 40 ft. (Weld., *Auvergne*, &c., 305), shows how cautiously inferences should be drawn as to the *artificial* origin of extraordinary appearances.

results of whose earliest outbreaks remain, not like those of the Earth, levelled by the fury of tempests, and smoothed by the flow of waters, but comparatively undegraded from their primitive sharpness even to the present hour. The ruggedness of the details, as old Hevel anticipated, becomes more evident with each increase of optical power, and we cannot doubt that we look upon the unchanged results of those gigantic operations which have stereotyped their record on nearly every region of the lunar globe.[1]

A brief general description of the phænomena of the Moon will prepare us for an examination of its topography. We have then

1. The *Grey Plains*, or *Seas* as they were formerly believed to be, and are still termed for convenience.[2] These are evidently dry flats—if the term 'flat' can be applied to surfaces showing visibly the convexity of the globe—analogous to the deserts and prairies and pampas of the Earth. B. and M. find that they do not form portions of the same sphere, some lying deeper than others: they are usually of a darker hue than the elevated regions which bound them, but, with a strong general resemblance, each has frequently some peculiar characteristic of its own.

[1] This is sufficiently correct as a popular view of the subject; but a more careful examination may require it to be somewhat modified. The varieties of colour, if not arising from vegetation, may indicate an amount of 'weathering' which must be great from the distance at which it is perceptible: nor can we confidently affirm that with powerful telescopes no traces can be detected of the hand of time.

[2] Riccioli, when he recast the lunar nomenclature, and substituted the names of philosophers for the feeble geographical analogies of Hevel, retained the generic title of 'seas,' though he altered their designations. The reform attempted by G., who would have had them called 'surfaces,' has never taken effect.

2. The *Mountain Chains, Hills,* and *Ridges.* These are of very various kinds: some are of vast continuous height and extent, some flattened into plateaux intersected by ravines, some rough with crowds of hillocks, some sharpened into detached and precipitous peaks. The common feature of the mountain chains on the Earth—a greater steepness along one side—is very perceptible here, as though the strata had been tilted in a similar manner. Detached masses and solitary pyramids are scattered here and there upon the plains, frequently of a height and abruptness paralleled only in the most craggy regions of the Earth.[1] Every gradation of cliff and ridge and hillock succeeds: among them a large number of narrow banks of comparatively slight elevation but surprising length,[2] extending for vast distances through level surfaces; these so frequently form lines of communication between more important objects,—uniting distant craters or mountains, and crowned at intervals by insulated hills,—that Schr. formerly, and B. and M. in modern times, have ascribed them to the horizontal working of an elastic force, which, when it reached a weaker portion of the surface, issued forth in a vertical upheaval or explosion. The fact of the communication is more obvious than the probability of the explanation.

3. The *Crater-Mountains,* comprising both the mound or wall, and the included cavity. These are the grand peculiarities of the Moon: commonly, and probably with correct-

[1] Schm. ascribes less rapidity to the gradients than is here supposed; very seldom exceeding 60°, never attaining in any extent 90°. Phillips was of an opposite opinion; but Ne. concurs with Schm.

[2] Schr. gives a length of 630 or 640 miles to a ridge connecting the spots Copernicus and Kirch. That they usually appear to take the direction of the meridian is simply due to the E. or W. *projection* of the shadows which make them prominently visible.

ness, ascribed to volcanic agency: yet differing in several respects from the foci of eruption on our own globe: on the Earth, they are usually openings on the summits or sides of mountains—on the Moon, depressions below the adjacent surface, even when it is a plain or valley; on the Earth, the mass of the cone usually far exceeds the capacity of the crater —on the Moon, they are much nearer equality; on the Earth, they are commonly the sources of long lava-streams —on the Moon, traces of such outpourings are rare; on the Earth, their number as well as dimensions are comparatively inconsiderable—on the Moon, M. considers that there are upwards of 1,000 visible with a breadth of 9 miles, and Schm. has drawn nearly 33,000 in all, so that they are the greatest characteristic of its surface, and, the grey plains excepted, among the largest of its features. When, however, allowance has been made for the inferior power of gravity on the Moon, through which a six-fold displacement in height or distance would be caused by the same amount of force,[1]—for the possible difference of materials,—and for the more rapid cooling produced by radiation in the absence of an atmosphere, it is quite conceivable that volcanic force, similar to that on the Earth, may have been the real agent, though in a greatly modified form. Any one may see, with the ingenious Hooke, a strong resemblance to the rings left by gaseous bubbles; but to this impression mechanical difficulties arising from the cohesion of materials have been opposed, and a more consistent explanation sought in the idea that the larger craters may be the remains of molten lakes; in these, left for a while unfrozen in the general cooling and crusting over of the once-fiery globe, an alternate shrinking and overflowing of lava, from a fluctuating pressure from beneath, might

[1] Mount Tongariro in New Zealand was, in 1875, throwing stones 8 miles from the crater.

gradually produce the existing forms. This theory has been recently extended and advocated with much ingenuity in the 'Selenographical Journal' by Green, who would substitute erosive for eruptive agency, even in the smaller craters; the undermining and re-dissolving power of fluid lava pressed upwards through the surface, and subsequently in many cases receding, being substituted for actual explosion. On this hypothesis the brighter and more elevated parts of the globe would, as a rule, date from a more ancient epoch than the darker and once fluid plains.

We have nothing on the Earth to be compared with the gigantic scale of the greater circles, though an extinct crater-plain, 20 miles in diameter, with peaks on its ring, is said to exist on the island of Mauritius: and the craters of the Sandwich Islands, Kirauea and Haleakala—the one a fused, the other a frozen, lake of lava, with the small 'blowing-cones' which eject only cinders and ashes—afford an analogy,[1] the striking nature of which will be apparent from the following representation of the latter, taken from a view in Elwes's 'Sketcher's Tour.'[2] Difficulties no doubt remain; but we can hardly wonder at them, while geologists are still so little agreed about 'elevation-craters' and submarine volcanos on our own globe. The circular cavities of the Moon are arranged in three classes,—*Walled* (or *Bulwark*) *Plains*, *Ring-Mountains*, and *Craters*: a fourth includes little pits without, or with scarcely a visible ring. The second and

[1] The craters of Java are also said to bear out this comparison.

[2] Haleakala, 'the house of the Sun,' in E. Maui, is of an oblong form, with two great openings in the wall, more than 30 miles in circumference, 10,000 feet above the sea, and about 2,000 feet deep. On the floor are 12 or 13 small red or yellow cones. The highest summits in the view are the two snowy volcanos of Hawaii, seen over the clouds in a very faint distance: our sketch gives only the *general effect.*

third differ chiefly in size; but the first have a character of their own;—the perfect resemblance of their interiors to the grey plains, as though they had been originally deeper, but filled in subsequently with the same material; many of them, in fact, bearing evident marks of having been broken down and overflowed from the outside. Their colour is often suggestive of some kind of vegetation, though it is difficult to reconcile this with the apparent deficiency of air and water. It has been ingeniously suggested that a low stratum of car-

Extinct Crater of Haleakala. (See p. 68.)

bonic acid gas—the frequent product of volcanos, and long surviving their activity—may in such situations support the life of some kind of plants: and the idea deserves to be borne in mind in studying the changes of relative brightness in some of these spots.[1] The deeper are usually the more

[1] The supposition, however, is said to be incompatible with the law of the diffusion of gases.

G. thought he perceived, in the grey tints of depressed surfaces, some of which vary with the amount of solar light, traces of several kinds of vegetation, comprised between 65° N. and 55° S.

concave craters; but the bottom is often flat, sometimes convex; and frequently shows subsequent disturbance, in ridges, hillocks, minute craters, or more generally, as the last effort of the eruption, central hills of various heights, but seldom attaining that of the wall, or even, according to Schm., the external level. The ring is usually steepest within (as in terrestrial craters),[1] and many times built up in vast terraces, or in parallel walls, frequently lying, Schm. says, in pairs divided by narrow ravines. Nasmyth refers these terraces—not very probably—to successively decreasing explosions; in other cases he more reasonably ascribes them to the slipping down of materials piled up too steeply to stand, and undermined by lava at their base, leaving visible breaches in the wall above: they would be well explained on the supposition just mentioned of fluctuating levels in a molten surface. Small transverse ridges occasionally descend from the ring —chiefly on the outside: great peaks often spring up like towers upon the wall; gateways at times break through the rampart, and in some cases are multiplied till the remaining piers of wall resemble the stones of a huge megalithic circle. A succession of eruptions may be constantly traced, in the repeated encroachment of rings on each other, where, as Schm. says, the ejected materials seem to have been disturbed before they had time to harden: the largest are thus pointed out as the oldest craters, and the gradual decay of the explosive force, like that of many terrestrial volcanos, becomes unquestionable. The peculiar whiteness of the smaller craters may indicate something analogous to the difference between the earlier and later lavas of the Earth, or to the decomposi-

latitude, and preserving the correspondence observed on the Earth between increasing latitude and elevation.

[1] Schm. gives 4° to 15°, and 20° to 50°, as the respective average *inclinations* without and within.

tion caused, as at Teneriffe, by acid vapours: in the grey levels we thus perhaps obtain an indication of the superficial character of their colouring.

4. *Valleys*, of ordinary character, are not infrequent; some of grand dimensions; others mere gorges. The most contracted of these latter are entitled to be classed apart as

5. *Clefts* (or *Rills* [1]). These were discovered by Schr.: G. and L. added to their number, which B. and M. raised to 90 in the text of their work; but the latter astronomer, on taking charge of the noble Dorpat achromatic, $9\frac{6}{10}$ in. aperture, perceived more than 150, and thought it might be possible to descry 1,000. Schm. published in 1866 a catalogue of 425, the greater part discovered by himself; and has since brought the number up to nearly 1,000. These most singular furrows pass chiefly through levels, intersect craters (proving a more recent date), reappear occasionally beyond obstructing mountains, as though carried through by a tunnel, and commence and terminate with little reference to any conspicuous feature of the neighbourhood. Ne. observes that they are frequently connected with valley-systems opening out of high lands, and often run down the centre of valleys. Klein says they are not common in the great plains. The idea of artificial formation is negatived by their magnitude; [2]

[1] An incorrect term adopted from the German, in which it does not imply, as in English, the presence of water.

[2] Schm. gives them 18 to 92 miles long, $\frac{1}{3}$ mile to $2\frac{4}{10}$ miles broad, and 100 to 430 yards deep. G., following out his strange theory that the Moon was once surrounded by an immense ocean which has wholly disappeared, considered the larger of these furrows as the beds of dried-up rivers; the smaller he referred to artificial clearings in the forests, answering the purpose of roads. It is to be regretted that the extravagance of his fancy should in many instances have brought discredit upon the unquestionable precision of his sight.

they have been more probably referred to cracks in a shrinking surface; a process which M. and others think may even now be in operation. The observations of Kunowsky, confirmed by M. at Dorpat and Schm., seem in some instances to point to a less intelligible origin in rows of minute contiguous craters; but a more rigorous scrutiny with the highest optical aid is yet required.[1] To these we may add

6. *Faults*, or closed, not open, cracks, sometimes of considerable length, where the surface on one side is more elevated than on the other. These familiar geological features have been recognised in abundance by Birt and With, and are more readily traced on the Moon than on the Earth, from the absence of superincumbent alluvial deposits and denudation.

Wonders are here in abundance for the student: but he will find it impossible to pursue them far from the terminator,—they must be viewed under the oblique rays of a rising or setting Sun. As the angle of illumination increases, a fresh aspect of things creeps in, and extends itself successively over the whole disc, and in its progress the inexperienced observer will find himself astonished at the change, and frequently bewildered in the attempt to trace out the landmarks of the surface. Objects recently well recognised under the relief of light and shade will become confused by a novel effect of local illumination, and the eye will wander over a wilderness of streaks and specks of light, and spots and clouds of darkness, where it may sometimes catch the whole, sometimes a portion, sometimes nothing, of many a familiar feature; while unknown configurations will stand boldly out defying all scrutiny, and keeping their post im-

[1] Klein, with a very sharp image and power upwards of 400, finds their breadth much more irregular than would be suspected *with* inferior means.

moveably till the decreasing angle of illumination warns them to withdraw. Nothing can be more perplexing than this optical metamorphosis, so complete in parts as utterly to efface well-defined objects; so capricious as in some instances to obliterate one, and leave unaffected the other, of two similar and adjacent forms. G., carrying out an idea of Schr.'s, referred some of these changes to the progress of vegetation, which, if existing, will naturally, in default of a change of seasons, run its whole course in a single lunation: even the cautious B. and M. have admitted that some variations of colour may possibly point in this direction; and photographic results seem to indicate the presence of green light not cognisable by the eye: but the general change demands a more universal solution; and probably a wide range of colours in the soil may be concerned in the effect. The subject calls for careful study, but would involve much laborious application.[1]

The most obvious features of the Moon under a high illumination are the *Systems of Bright Streaks* which issue, though in widely differing proportions, chiefly from seven different centres: all craters, few inconsiderable, but none of the very largest class. In some cases the streaks proceed from a circular grey border surrounding the crater; in others they cross irregularly at its centre. They pass alike over mountain and valley, and even through the rings and cavities of craters, occasionally reach the terminator,[2] and seem to defy all scrutiny. Nichol asserts that in some contiguous systems, the order of formation may be detected from the

[1] The polarisation of light by the Moon was found by Secchi to be entirely different in the lowlands and in the mountainous parts. Birt sees a greenish tint in the plains under very oblique lights.

[2] Ne. remarks this, in opposition to B. and M., and says that some of the Tycho streaks shift a little with varying libration.

mode of their intersection;[1] a statement well deserving the notice of those whose telescopes will carry them through the inquiry. But one thing is certain, that they are very seldom accompanied by any visible deviation in the superficial level; a fact irreconcileable with Nasmyth's conjecture, that they are cracks diverging from a central explosion, filled up with molten matter from beneath; trap-dykes on the Earth are, indeed, apt to assume the form of the surface, but the chances against so general and exact a restoration of level, all along such multiplied and most irregular lines of exposure, would be incalculable: many of the rays are also far too long and broad for this supposition, or for that of B. and M., that they may be stains arising from highly heated subterraneous vapour on its way to the point of escape.[2] The extraordinary brilliancy of some portions of the Full Moon is less difficult of explanation, when we bear in mind the effect of chalky strata, or that peculiar kind of granite which on the loftiest peaks of the Himalayas may readily be confounded with the adjacent snow. In many cases the form of the surface gives us no key to the distribution of this vivid reflection; in others it occupies a marked position, as on the summit of rings and central mountains: the idea of a mirror-like glaze reflecting an image of the Sun, though entertained by such authorities as B. and M., seems difficult to be reconciled with the ever-varying angle of illumination.

A scale of reflective power has been adopted from Schr. by later selenographers, in which (blackness being o) the

[1] The following, according to him, is the chronological order of three great systems: *Copernicus, Aristarchus, Kepler.*

[2] Schwabe suggests that they may be due to contrast: a shade being formed in their intervals as the day increases by a multitude of thin converging or parallel grey lines, which may be seen by a good instrument, and which may possibly result from some kind of *vegetation.*

darkest grey shades rank as 1°, the brightest portions 10°. This is of some use, though merely arbitrary. A more reliable plan, especially in combination with such a scale, would be the mode of comparative values, in which the light of any given spot is referred to others above and below it in brightness. Changes are more than suspected in the reflective power of portions of the lunar surface, and it would be interesting to examine it in that aspect; but we have no good map of the Full Moon, and if we had, it never could adequately express the various gradations of brightness, which must be the object of topographical study.

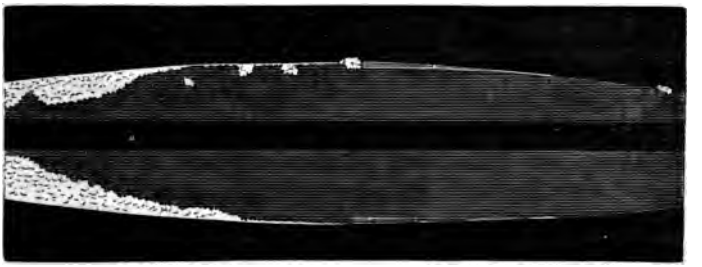
A few *peculiarities of arrangement* deserve to be mentioned here. The remarkable tendency to circular forms, even where explosive action seems not to have been concerned, as in the bays of the so-called seas, is very obvious; and so are the horizontal lines of communication already mentioned. The gigantic craters or walled-plains often affect a meridional arrangement: three huge rows of this kind are very conspicuous, near the centre, and the E. and W. limb. A tendency to parallel direction has often a curious influence on the position of smaller objects; in many regions these chiefly point to the same quarter, usually N. and S. or NE. and SW.; thus in one vicinity (between **G**, **L**, and **M** on the accompanying map) B. and M. speak of 30 objects following a parallel arrangement, for one turned any other way; even small craters entangled in such general pressures (as round **L**), have been squeezed into an oval form; and the effect is like that of an oblique strain upon the pattern of a loosely-woven fabric: an instance (near **27**, **28**) of double parallelism, like that of a net, is mentioned, with crossing lines from SSW. and SE. Local repetitions frequently occur; one region (between **290** and **292**) is characterised by exaggerated central hills of craters; another

great map of Schm.—admirable as it is in its own way—that of representing objects in only one aspect, and that a conventional one. This defect is of course inherent in every general map, and can only be supplied by topographical sketches, after the manner of Schr., giving repeated views of the same object under differing angles of illumination and reflection. As yet, this has been only partially attempted. We have no monograph representing any one spot for each successive night of its visibility, and in varied conditions of libration: but such a series would be very instructive, as well as valuable for the future. But we must not omit to do justice to the indefatigable as well as accurate labours of Birt, continued through many years, and adding very materially to our knowledge of lunar detail; and much is to be hoped from the researches of the Selenographical Society, established in London in 1878, which, comprising many eminent English and foreign astronomers, has for its object the collection and preservation of observations, and the indication of the most promising lines of research.

Little of a satisfactory nature can be said as to a *Lunar Atmosphere*. That its density cannot amount to $\frac{1}{150}$ of that of our own is demonstrable from theory, and proved by observation, which shows us a sharp outline, and detects no change in the aspect of stars in contact with the limb:[1] and hence its entire absence has been maintained by great astronomers: Schr. asserted its existence from many changes of aspect in minute objects, and from a very dim twilight which he traced through 9 years beyond the points of the horns; his inferences are supported and in part exceeded by G., who

[1] It has been ascertained of late years that the Moon's observed diameter exceeds by 4″ that computed from occultation of stars. *This appears* too much to be explained by irradiation.

frequently saw—or imagined—fogs and clouds resting on the surface; nor is Klein disposed to deny the probability of such obscurations, especially in deep places. The defined limb and the absence of refraction are accounted for by Schr. by limiting the sensible atmosphere to the inferior regions. B. and M., while explaining away—not very satisfactorily—Schr.'s twilight, which they could never distinctly find, do not deny the possibility of a very rarefied gaseous envelope.[1]



Those traces of twilight, which have been confirmed by G. and recently by MM. Henry with a large telescope at Paris,

[1] Some very curious photographic experiments by De La Rue have been thought to tend the same way. It seems hardly probable that oxygen, which forms $\frac{1}{8}$ of the weight of terrestrial earths, should be entirely absent from the Moon; and the whiteness of the small craters in the grey plains is a suggestive fact. Schm. has in a few instances (to which he might have added one from Schr.), seen a grey border to the black shadow in craters, but this he ascribes to its being thrown from a very ragged edge. Schr. and other observers have noted occasional want of definition in certain spots as compared with others. In a few cases M. and Schm. have perceived a blue tint round bright points on the terminator, probably, as Schm. says, due to the 'secondary spectrum' of all achromatics. De La Rue's remark is important, that it is difficult to conceive any chemical formation of matter without an atmosphere.

and which I imagined I saw, 1855, June 20, but only doubtfully from want of better optical means, might well engage the student's attention: in order to assist him two figures are here given from among Schr.'s numerous delineations. They represent the cusps of the Moon as seen by him, 1792, Feb. 24, with a 7 f. reflector by Herschel I., powers 74, 161.

Occultations of planets or stars, which are important to the professed astronomer, are interesting to the amateur as bringing out distances and motions of which the naked eye takes little cognisance: the comparative nearness of our satellite becomes self-evident, and its orbital movement is made apparent from minute to minute. A grand effect is produced by the visible sailing of this ponderous globe through immeasurable space; and it may well convey a deep impression of the omnipotent Power and consummate Wisdom which orders its undeviating course. The instantaneous extinction, too, and sudden flashing out of a large star in these circumstances are very striking, though less instructive than might have been expected as to the question of an atmosphere: the immersion and emersion are usually as sudden as if none existed; but this may be accounted for by the rapid motion of the Moon, or, on Schr.'s theory, by the elevation of that portion of the limb: the gradual extinction sometimes recorded may be only due to irregularities on the edge: the distortions or flattenings occasionally noticed in the shape of planets at occultation are too extensive for any such cause, and must be referred to optical illusion.[1] All occultations of importance are predicted in the Nautical Almanac; the most beautiful are *immersions*

[1] See Proctor's very ingenious illustration of such deceptions under the head of *Saturn*.

behind the *dark* limb when the latter receives a strong earth-light, as between New Moon and I. Quarter.[1]

The *projection* of a star upon the Moon, just before immersion, as if it advanced in front of it, is very difficult of explanation. South, after a careful examination of the instances on record, was unable to come to any satisfactory conclusion: it is an occurrence of the most capricious kind, which can never be predicted for any star, eye, or telescope; and is evidently an optical, not astronomical, phænomenon.

Libration must be well understood, before proceeding to topography. This is an apparent displacement of the spots with respect to the limb (or centre), arising in one direction (that of lunar longitude) from the equable rotation of the Moon on its axis combined with its unequable velocity in an elliptical orbit, in another direction (that of latitude) from the inclination of its orbit to the ecliptic in conjunction with a slight inclination of the axis to the plane of the orbit: it completes its changes in about four weeks, though an exact restoration of the position called 'mean (or medium) libration' does not take place till the end of three years. Hence, the usual statement that we see always the same hemisphere is only approximately true. The spots are constantly swinging a little backwards and forwards, and those near the E. and W. limbs going alternately out of sight; while, as our eye rises successively above each pole, a little more or less of those regions is seen,—the whole area thus concealed and exposed by turns amounting to $\frac{2}{11}$ of the surface of the globe.[2] No map of the Moon, therefore, can correctly represent its whole aspect on two following nights, and they are of course con-

[1] Kunowsky has seen the dark limb sharply defined $3^d\,4^h$ after I. Quarter. G. professed that he was able to trace the larger seas on the dark side with the naked eye.

[2] Proctor, *The Moon*, 197.

structed to correspond with a state of mean libration. The displacement of the spots, which amounts at a maximum to 6° 47′ N. and S., 7° 55′ E. and W., and 10° 24′ from a concurrence of both, in either direction from a normal position, produces little effect upon the aspect of the central parts, which are merely shifted with regard to the Moon's equator or 1st meridian; but in the foreshortened neighbourhood of the limb its results are very obvious. Fresh regions constantly take the outline of the disc, and the mountainous projections of to-night may be all out of sight to-morrow. One effect of libration is, that the spots have no fixed position with respect to the Moon's age, being sometimes earlier, sometimes later, on the terminator, so that no precise instructions can be given when to look for them; it may be useful, however, to know that, as Birt has pointed out, the terminator passes through very nearly the same part of the surface at recurring intervals of $59^{d}\ 1^{h}\ 28^{m}$. A few approximations alone will be found in these pages, especially as a little practice with the map will render identification easy: the following considerations, however, may be useful to the beginner:—

The relief of the surface will be stronger as it is nearer to the terminator, and all delicate and difficult objects are best seen near the sunrise or sunset of the Moon, which, like the corresponding times of the Earth, abound with grand and beautiful effects of light and shade. Every little irregularity then assumes temporary importance; inconsiderable hillocks, minute craters, low banks, narrow canals, become visible in the horizontal ray; rising grounds or soft valleys seem to start into existence, the outer slopes of craters advance into the surrounding levels, larger masses appear in exaggerated prominence,

Majoresque cadunt de montibus umbræ.

These broad and deep shadows often taper off to such slender points, that a caution may be requisite, not to infer anything extravagant respecting the sharpness of the form which casts them. It may be questioned whether anything in the Moon exceeds the acuteness of the Swiss Finsteraarhorn, or the abruptness of the Pic du Midi d'Ossau in the Pyrenees. An oblique light cast upon a rough surface, modelled in clay or dough, will show how disproportioned oftentimes is the shadow to the reality; and the same experiment will prove to us that in many cases the true relief will be unknown till the shadow on either side of the object has been examined. The intense blackness of the lunar shadows gives an effect which must be strangely contrasted with a distant prospect of our Earth. Here, a highly reflective and vapour-charged atmosphere surrounds all objects with a constant illumination, beginning before sunrise and outlasting sunset; there, the Sun goes up and down in noonday strength, and the shadows are unrelieved by any reflection from a sky which must be almost black all day: every mountain produces utter darkness where it intercepts the Sun; and every crater, while its ring is glittering like snow in the rising or setting beam, is filled with midnight shade. Dawes, alone, by employing the contracted field of his solar eye-piece, has traced a very faint glimmering in these depths, produced by reflection from the opposite sunlit cliffs.[1] The terminator is, indeed, marked through the grey plains by a narrow shadowy border, and the tops of the mountains just appearing or

[1] Schm. twice saw the innermost cavity of the peculiarly shaped crater 399 feebly illuminated at sunrise, as though filled with mist. He prefers an explanation identical with that of Dawes; but qu. as to its adequacy under the circumstances? Another large crater near S. pole also twice showed a similar internal twilight.—Compare appearance of 132, *Eng. Mech.* 1871, Dec. 25; 1872, Mar. 15.

vanishing in the night-side are somewhat deficient in brightness; but this is the 'penumbra,' or partial illumination, due to a portion of the Sun's disc, while the rest is beneath the horizon. In other respects the glittering sharpness of the Moon's sunrise, or sunset, is widely contrasted with the softness of our own skies. But though it is then that we must watch for minute details, for large objects we shall find the relief too broad and partial; unbroken night conceals the greater cavities, and the shade of loftier summits renders lower ranges invisible. Not till day descends among the terraces of the one, or creeps down over the shoulders and along the slopes of the other, does their true structure come out; and their distinctness increases while their minuter neighbours decline into insignificance.

L.,[1] and B. and M., have done admirably well in their delineations. Yet a little experience will show that they have not represented all that may sometimes be seen with a good common telescope. My own opportunities, even when limited to a $3\frac{7}{10}$ in. aperture, satisfied me, not only how much remains to be done, but how much a little willing perseverance might do, provided there were some knowledge of the laws of perspective and shadow, and a due attention to the direction of the incident and reflected light: some facility in design would also be very desirable, and, if proportion is tolerably preserved, a number of rough sketches under varied lights taken at the eye-piece, and carefully compared with the original, would be more serviceable than one or two finished drawings. Detail being the great object, a small portion

[1] His general map is valuable, and not expensive; but the scale, $15\frac{1}{4}$ inches, is rather small, and the deviations from circularity in the craters exaggerated. The discontinuance of his 'Sections,' on a 3 f. (French) scale, from failing sight, was long a serious hindrance to selenography; but the missing portions have been recovered, and *recently published* under the careful editorship of Schm.

only should be attempted at once; this will not merely be easier and more pleasant, but will avoid the change in the shadows, which is considerable near the terminator during a long-continued delineation. The record, to be of value, must possess four data: 1. *Hour of Observation*;—2. *Moon's Age*, reckoned from or to the nearest change;—3. *Position of Terminator* referred to well-marked spots, some nearly in the latitude of the observed region; others a good way N. and S. of it, so as to show the direction of illumination, which is seldom exactly at right angles to the lunar meridian:—4. *Libration*, indicated (i) in longitude, by time reckoned to or from nearest perige or apoge; or both may be specified; (ii) in latitude, by Moon's latitude at the time; these particulars being taken from 'Nautical Almanac,' and the last reduced to the hour of observation. More than this cannot be ascertained without a micrometer or calculation; but this is enough for the comparison of delineations. If the last two data are nearly coincident in any observations, the angles under which the landscape is illuminated and viewed differ so little that any variation in its details must be referred to either—1. inadvertence or mistake in the observer; —2. actual change in the Moon's surface; or 3. obscuration or deception in her atmosphere. Schr. relates so many instances of the latter kind that, even if we reject the confirmation of the keen-eyed but fanciful G., it seems difficult to follow B. and M. in disposing of them all as errors of observation; nor does Klein, a very accurate living observer, think the inquiry by any means unworthy of special notice. One important caution seems not to have occurred to Schr.: the change of lunar seasons, slight as it is, somewhat affects the direction of the shadows; and the variations of foreshortening from libration may make them more or less visible; and thus some apparent discrepancies might be reconciled. With large

apertures, a lightly tinted screen-glass works well ; possibly the use of different colours might bring out some curious result.[1]

A good popular Map of the Moon has been hitherto a desideratum in England. B. and M.'s smaller map, though very inexpensive, is scarcely known here ; and is rather crowded. Russell's and Blunt's, striking as to general effect, break down in details. Those in ordinary books of astronomy are especially useless. The one here given will, it is hoped, be found less defective : it makes no claim to pictorial resemblance, and professes to be merely a guide to such of the more interesting features as common telescopes will reach. It is carefully reduced from the 'Mappa Selenographica' of B. and M., published in four sheets in 1834, and subsequently re-edited, on a scale of 3 f. $1\frac{1}{4}$ in. (3 French f.), omitting an immense mass of detail accumulated by their diligent perseverance,[2] which would only serve to perplex the beginner. Selection was difficult in such a crowd ; on the whole it seemed best to include every object distinguished by an *independent name*, including the recent additions ; many of little interest thus creep in, and many sufficiently remarkable ones drop out ; but the line must have been drawn somewhere, and perhaps would have been nowhere better chosen for the student. Other spots, however, have been admitted from their conspicuousness, to which B. and M. have given only a *subordinate* name ; minuter details come in, in places, for ready identification ; elsewhere, larger

[1] See De La Rue, on increased distinctness during advance of lunar eclipse, *Monthly Notices*, xxv. 276.

[2] Some idea may be formed of this, from the 919 micrometrical measures of the position of spots, and 1,095 of heights and depths, contained in their work *Der Mond*. Schm., however, has left them far behind.

objects are passed by, as less useful for the purpose of the map. The nomenclature is almost identically that established by B. and M., as rectified and extended by Neison. Hevel (or Hevelius), in the earliest attempt, designated different regions of the Moon from supposed geographical analogies; but this system has long been abandoned, except in the case of some mountain ranges. Riccioli, a far inferior observer, adopted a more available method, originally adopted by Langrenus, of affixing to the larger spots the names of distinguished philosophers; his list was increased by Schr., who made each name include the adjacent objects, by adding the letters of the alphabet; and this system, improved and generalised, has been applied by B. and M. to the whole disc; the name used alone distinguishes the principal object; Greek or Roman letters added to it signify respectively the elevations or hollows in the vicinity. To avoid crowding our map, letters and numbers are substituted for names; every object in the descriptive notices will be thus referred to, but, as this selection is limited, a complete list of the names given by Ne. is subjoined, which will also secure, in all cases, the important object of identification as far as it goes. The alphabetical arrangement which follows it may be found convenient.

The remark is scarcely needed that the student who aims at more than a superficial knowledge of this very interesting subject will require further aid than he can derive from these pages, or from the accompanying map. The larger of the maps of B. and M. will help him greatly, especially if, as a German student, he can avail himself of their corresponding work, 'Der Mond;'[1] or, if economy is an object, their own

[1] A little work by Schm. under the same title could not be substituted for it as a text-book, but is very pleasing and interesting, and well worthy of translation.

abridgment of it. In point of comprehensiveness, nothing can equal the magnificent map of Schm., 6 French f. in diameter, in 25 sections, published, to their great honour, by the Prussian Government. It is the fruit of 34 years' labour, and the surprising number of 32,856 craters which it is said to contain sufficiently bespeaks its minuteness. It has, indeed, one very serious fault—namely, the exaggeration of the importance of low banks and ridges by a disproportioned depth of shade; and in this respect it is inferior to the map of B. and M. But its mass of detail, unique as it is, cannot supersede the necessity of verbal description; and here the 'Moon' of Nelson will render such invaluable service that it can hardly be dispensed with. It is illustrated by a map in sections, less minute than that of Schm., but quite sufficient for the majority of students; and our choice, if limited to a single manual, would fall without hesitation on this eminently careful and faithful work.

The points of the *Lunar Compass* must be mastered before we can use the map. Astronomers have fixed these from their relative, not intrinsic, position; that is, the several portions of the disc are named from the adjacent quarter of the sky when the moon is on the meridian. Hence N. and S. occupy the top and bottom, but E. and W. are reversed, as compared with terrestrial maps: the former being to the left, the latter to the right. But maps of the Moon usually represent its telescopic—that is, inverted—appearance, so that we shall find S. at top, N. at bottom, E. to right, W. to left. The meridians and parallels of latitude have been omitted, except the 1st Meridian and Equator, which divide it, like the original, into Four Quadrants: these are called by B. and M., the 1st or NW., 2nd or NE., 3rd or SE., 4th or SW. Quadrant. A selection of the most interesting objects in each follows, from materials furnished

by the 'Mond' of these astronomers, and retaining their arrangement: additions are made from other sources; but all statements not otherwise authenticated depend upon their authority. In the more remarkable instances, their measures of height and depth are given; these were ascertained by the lengths of the shadows—a method previously employed with less accuracy by Schr.; capable of much precision on favourable ground, but elsewhere uncertain. For our present purpose round numbers will be a fully sufficient approximation.[1]

First, or North-West, Quadrant.

Mare Crisium (**A** on the map). We begin with a conspicuous dark plain, the most completely bounded on the Moon, and visible to the naked eye: apparently elliptical from foreshortening, but really oval the other way, being about 281m. from N. to S., 355 from E. to W., and containing about 66,000 square m., or $\frac{1}{94}$th part of the visible hemisphere—more than half as much again as the area of England and Wales. Its grey hue has a trace of green in the Full; this has also been represented by the present talented Astronomer Royal for Scotland, C. Piazzi Smyth, in two beautiful figures taken during the increase and wane. On rare occasions it has been seen by Schr., and in part by B. and M., speckled with minute dots and streaks of light: something of this kind I saw with a fluid achromatic, 1832, July 4, near I. Quarter. A similar appearance was noticed by Slack, and Ingall, 1865. It would be difficult to say why, if these are permanent, they are so seldom visible—a

[1] Minuteness of numerical detail in astronomical results should not be misunderstood. It represents no natural fact, but only the care bestowed upon measurement.

suggestive, though at present unintelligible, phænomenon. The surface is deeply depressed, lower than Mare Fœcunditatis and M. Tranquillitatis. Many low ridges cross it in a N. and S. direction; but in this, as in many other cases, it must be remembered that those lying E. and W. would be imperceptible for want of shadow. The boundary mountains are in part very steep and lofty. The PROMONTORIUM AGARUM (1) rises about 11,000 f.; a mountain SE. of Picard, 15,600 f., rivalling our Mont Blanc. On W. edge, Schr. delineated a crater called by him ALHAZEN, which he constantly employed to measure the existing libration: he saw in it after a time unaccountable changes, and since, it has been said, it cannot be made out. B. and M. think he confounded it with a crater (2) lying farther S.; G., however, drew it in 1824; the question, which was debated among Kunowsky, Köhler, and others, has been cleared up by Birt, who has recovered Schr.'s crater, between two lofty mountains; the cause, however, of its greater obviousness in Schr.'s earlier days still offers some difficulty. The plain contains several moderate-sized craters—the largest, PICARD (4), S. of which G. saw some curious regular white ridges like ramparts; while on the W., Birt and Ingall have pointed out a remarkable bright patch, which subsequently faded to a great extent, and which, according to Espin, marks a depression. The next crater N. (PEIRCE) has a very minute interior craterlet, discovered by Schm.—a test-object. The next crater N. of this (PEIRCE A) Birt has sometimes been unable to find. There are also several very minute craters in the level. Near the E. edge, where there is a pass in the great surrounding ridge between **450** and **451**, lie several small, but in part lofty, mountains,[1]—islands, as it

[1] These are ill-figured in the great map, and B. and M. have *given* a separate representation of them in their *Mond*.

were ;—among these Schr. describes singular changes, which he refers to an atmosphere ; B. and M. consider them merely varied illumination, or pass them by as unworthy of attention. Succeeding observers may revise, even if they ultimately acquiesce in, this summary decision. Schr. was a bad draughtsman, used an inferior measuring apparatus, and now and then made considerable mistakes ; but I have never closed the simple and candid record of his most zealous labours with any feeling approaching to contempt ; and though there may be truth in the assertion of B. and M., that he was biassed by the desire of discovering changes, they, possibly, were not themselves free from an opposite prepossession.

A long winding cleft is suspected to cross the centre of **A**.

Central hills seldom occur in craters here.

A may be well seen about 5^d after New, or 3^d after Full ; in the latter case it is a magnificent spectacle when crossed by the terminator and partially covered in by the vast shadows of the mountains, from which Schr. considered that those on NE. side must be at least 16,000 or 17,000 f. high.

This astronomer has inserted in his work a marvellous observation by Eysenhard, a pupil of Lambert, 1774, July 25. The night being perfectly clear, he saw with a common 4 f. refractor four bright spots in **A**, then intersected by the terminator, two of which only—those on the day-side—can be identified ; after noticing them at times for 2^h, he found all at once that the part of the terminator in **A** had a slow reciprocating motion, completed in 5 or 6^m, between these pairs of spots, each pair being touched by it in turn. Two other refractors of 7 and 12 f. showed this appearance with equal distinctness, and it was observed for 2^h, the terminator in **X** remaining perfectly still. A very strange story, yet Lambert seems to have believed it; and perhaps

we cannot pronounce it wholly incredible in the face of an equally wonderful and perfectly well-attested retrogression in a satellite of Jupiter, to be described hereafter.

Between FIRMICUS (7) and the limb, half-way in mean libration, are some curved dark streaks (*Paludes Amaræ*, Hevel), in which B. and M. found singular variations, resulting, as they admit, possibly (not probably) from periodical vegetation.

CLEOMEDES (12), a walled plain 78 m. in diameter, includes a small crater (Cleomedes A), brilliant, but not always alike defined, in Full; Schr. had found it not always equally visible. He speaks of many variations in the interior level, which he represents rather differently from B. and M.—G. found its W. part marked out into many rhomboids—squares in perspective, since confirmed in part by Ne.

BURCKHARDT (19), 35 m. in diameter, lies 12,700 f. below its E. wall.

GEMINUS (20), 54 m. broad, has a ring 12,300[1] f. high on E., 16,700 f. on W. side.

BERNOUILLI (21), equally deep, is very precipitous.

GAUSS (22) is a walled plain, 110 m. long. B. and M. describe the fine effect of sunset upon its ring. It has a grand central mountain, which must at times command a glorious view, across a plain of 50 m. covered with night, to illuminated peaks all round the horizon, above which the Sun on one side, and the Earth on the other, are slowly coming into sight.

[1] By a singular coincidence, in reducing as usual French to English measure, the resulting number was 1, 2, 3, 4, 5, with 6 in the first place of decimals. The chances against such a sequence must have been extremely great; but it exemplifies a principle, not always kept in mind, that so long as a thing is *possible*, it must *sometimes* occur.

STRUVE (**25**), a slight depression, is remarkably dark in Full.

ENDYMION (**27**), a walled plain 78 m. in diameter, is, in some states of libration, very dark in Full: the irregular wall rises W. to more than 15,000 f., overtopping all but the very highest peaks of our Alps. I have seen it in grand relief $3^d\ 7^h$ after New, $2^d\ 9^h$ after Full. Between **27**, **28**, and **29** is a curious double parallelism, objects all ranging SSW. or SE.

ATLAS (**28**). A superb amphitheatre 55 m. broad, 460 square m. in area; its ring rich in terraces and towers, rising 11,000 f. on N.; a very dark speck in interior, where I have also seen some clefts with Bird's 12 in. silvered reflector.

HERCULES (**29**). A worthy companion to it, 46 m. across. The ring, in places double, includes a small crater of subsequent date, and according to Schr. a central mountain, not seen by others. Look for this pair 5 or 6^d after New, $3\frac{1}{2}^d$ after Full.

FRANKLIN (**32**). Several incomplete rings lie hereabout, all open N.

DEMOCRITUS (**38**), a deep ring-plain, lies at the beginning of a region remarkable for net-like and often quadrangular forms. Craters and ring-plains are not, however, absent. Among the latter the dark and level interior of MOIGNO (**408**) bears a small but conspicuous crater.

MARE HUMBOLDTIANUM (**B**), discovered by B. and M.,[1] is

[1] Part, however, is shown on Russell's Lunar Globe (1797), beautiful as a work of art, poor in detail. A larger globe by the same observer, in relief, is preserved in the S. Kensington Museum. Mme. Mädler modelled a lunar globe in wax. Mme. Witte, a Hanoverian lady, has completed a very perfect globe in relief, from B. and M.'s observations and her own. There is at Bonn a magnificent relief of the Moon, 18 Paris f. in diameter, executed under Schm.'s direction by Dickert (1854). Sir Chr. Wren, when Savilian

rather more than half as large as M. Crisium, but close to the limb, above which the peaks of its W. border sometimes appear in profile, in one part 16,000 f. high.

In this region, in certain states of libration, occur two singular flattenings of the limb, divided by a ridge. These, with another, were discovered by Key, 1863. One of them extends for 10°.

GIOJA (**44**) is the nearest visible formation to N. Pole, which, however, owing to foreshortening, is at some distance beyond it.

MOUNT TAURUS (**51**) is a lofty range, containing the terraced crater RŒMER (**52**), 26 m. wide, 11,600 f. deep.

POSIDONIUS (**54**). This walled plain, nearly 62 m. across, includes several small details, in which Schr. found repeated changes: the shadow in the bright little crater was abnormal in length, and once replaced by a grey veil. B. and M. never saw anything unusual. Schm. found it once, but under bad circumstances, 1849, Feb. 11, shadowless: so G. 1821, Apr. 7. It has been finely drawn by Gaudibert, *English Mechanic*, 1872, Mar. 1. It contains 7 clefts. A good object about 6^d after New.

LITTROW (**55**) and MARALDI (**56**) show the SSW. parallelism of the vicinity: VITRUVIUS (**57**), with a very dark interior, lies in a mottled region, in one place slightly tinged with blue.

MOUNT ARGÆUS (**58**). A small range gradually rising from W. to a summit, ranked by Schr. as high as the loftiest of our Pyrenees (N. gives 8,400 f.), and then sinking, on its NE. face, in an amazing precipice, down to the wide plain. It is remarkable for the spire of shade which it casts at sun-

Professor at Oxford, made a lunar globe in relief at the request of the Royal Society and by command of Charles II., who placed it in *his cabinet*. We must hope that it has been carefully preserved.

rise; but it has been unfairly treated by B. and M., being omitted from their nomenclature, which contains many very inferior hills: as it is so interesting an object, I hope I am not guilty of presumption in assigning a name to it, chosen from its vicinity to **51**. It requires close watching, as the shadow rapidly loses its slender point; look for it when the ring of **61** just heaves in sight beyond the terminator. I have seen it thus $4^d\ 21^h$ after New.

MACROBIUS (**59**), nearly 42 m. broad, sinks almost 13,000 f.

PROCLUS (**60**) has a ring, next to **148** the most luminous part of the Moon; yet scarcely ever visible on the dark side; very much less so than many duller objects. B. and M. ascribe this to the narrowness of the wall. It is the centre of several bright streaks, not very easily seen.

PALUS SOMNII (**F**), an uneven, defined, always distinguishable surface, has a peculiar tint, perhaps yellowish-brown, unlike the simple grey of MARE TRANQUILLITATIS (**G**). The latter in Full is sometimes strewed with very small bright points.

PLINIUS (**61**). A terraced ring, 32 m. in diameter, filled with hillocks. N. lies a broad cleft, with a smaller one farther out, and a very minute one between them.

MENELAUS (**70**). A very steep crater about 6,600 f. deep; with a ring very brilliant in Full. All the ridges running from it trend SW., and this parallelism reaches over a great district, including most of **85**, **68**, **L**, and the vicinity. Several bright streaks issue from **70**—one is a continuation of a ray from **180**, extending in all more than 1,850 m. Here was one of Herschel I.'s pseudo-volcanos.

MARE SERENITATIS (**H**). This wide and beautiful plain is nearly circular, about 433 m. from N. to S., 424 from E. to W.; the interior appeared at Full to B. and M. of a clear light green, unnoticed by Schr. and L., and not easily seen

even by its discoverers; it is set in a border of dark grey, and bisected by a straight whitish streak, invisible, like most of its class, near the terminator. Towards the W. edge of the plain is a curious long low serpentine ridge, discovered and figured by Schr., but only well seen from its shadow near the terminator. I have found it thus between 5 and 6^{d} after New. A little E. of it I have seen a lower one with reverse flexures.

LINNÉ (**74**). A small crater, described by L. as 'very deep,' and by B. and M. as 'deep,' but discovered by Schm. to have entirely lost that character, and to resemble a *whitish cloud*, surrounding a most minute elliptic crater, which I have seen beautifully on rare occasions with 9$\frac{1}{3}$ in. mirror. This very interesting spot has undergone a rigorous scrutiny, and opinions are still divided, owing to some want of explicitness in the earlier records. The balance, however, seems decidedly in favour of actual change: and this and many other spots would have been more carefully observed, could it have been foreseen that questions would subsequently be raised about them.

CAUCASUS (**75**). This grand mountain mass rises into insulated peaks, suitably termed 'aiguilles' by B. and M., as lofty as any on the Moon, those on the limbs excepted, and reaching 18,000 or 19,000 f. Their narrow shadows are drawn out into fine points—a superb spectacle, which I have seen about I. Quarter. Craters are very rare here.

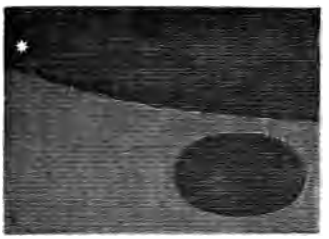
EUDOXUS (**77**) and ARISTOTELES (**78**). A noble pair of craters, not easily found in Full, in a region sprinkled as it were with luminous dust. The terraced wall of **77**, 11,300 f. above the W. interior, is on that side crowned by two turrets of 15,000 f. Etna, as Schr. observes, would stand in this great cavity. **78** is more than 50 m. broad, nearly as deep *as* **77**, but with a much richer wall. The interior of both

resembles the surrounding country more than is usual. I have seen a row of 4 or 5 craterlets in **78**, running SW. from the central hill—a test-object. **78** is very remarkable for rows of minute hillocks lying NE., NW., and SW., in lines pointing to the crater—the finest specimen of this not uncommon arrangement: it is less distinct round **77**. It requires very favourable light, and is difficult for the student. I have seen it, with wide SW. libration, about I. Quarter. S. and SW. of **77** the surface down to **H** is thronged with hillocks, and W. especially, craterlets innumerable; on E. these mounds reach to **75**. Many small craters and a little cleft (crater-row, Schm.) NE. of **78** are omitted by B. and M.

GREAT VALLEY OF ALPS. An extraordinary cleft, figured by Bianchini in his work on Venus; a circumstance unnoticed alike by Schr., B. and M., and Schm. About 83 m. long, and from $3\frac{1}{2}$ to $5\frac{3}{4}$ m. broad, it breaks in a straight line through the very loftiest Alps, with precipitous sides and a depth of at least 11,500 ft., in which Mont Perdu or the Vignemale of the Pyrenees would disappear. The bottom is very flat, but high powers according to Klein show landslips from the edges. It is always easily found. Between this valley, **79** and **I**, lies a curious region all sprinkled with hillocks: B. and M. estimated them at 700 or 800 at least. I once saw them finely developed at I. Quarter, in a 20 f. achr. by Slater, of $14\frac{3}{4}$ in. aperture.

ALPS (**80**). A lofty and exceedingly steep chain, rising into separate peaks: one of the highest, the Mont Blanc of Schr. (next to which our number stands), reaches, he says, to 14,000 f. B. and M. reduce it below 12,000 f. Close beneath its E. foot, Schr. perceived, 1788, Sept. 26, on the dark side of the Moon, a small speck of light, like a 5 m^{s}. star to the naked eye, which having been verified in position, and kept in view for fully 15^{m}, disappeared irrecoverably: the round

shadow, sometimes black, at others grey, which he subsequently found in the day-side in or near its place, was probably nothing new. A copy of his figure is here given. Strange to say, 1865, Jan. 1, Grover recovered this bright spot, or one very near its site, with only 2 in. of aperture, and saw it unchanged like a 4 m^g. star to the naked eye, but rather larger, for fully 30^m.



PALUS NEBULARUM (I) and PALUS PUTREDINIS (K) are for the most part so level, that mounds of 50 or 60 f. would be rendered visible by their shadows near the terminator.

CASSINI (81). A curious ring-plain; the narrow wall encloses a scarcely depressed space, and a small deep crater, which has a considerable irregularity within, unnoticed by B. and M. but not new, as I saw traces of it in 1826. The ring casts long spires of shade about I. Quarter. An insulated mountain E. of it in the plain (477, *Mons Christi*, Hevel), usually very bright, was once seen by Schm. near lunar sunset of a remarkable dark grey. G. had noted many changes in its form and colour, which he ascribed to lunar clouds.

THEÆTETUS (82) would take in Snowdon twice over, with still depth to spare.

ARISTILLUS (83), a very magnificent crater, 34 m. broad, 11,000 f. deep on E. side, has a fine central mountain, which I saw, with $5\frac{1}{2}$ in. of aperture, as three parallel ridges. The ring stands up nobly from the plain, and is flanked on all sides (as Schr. perceived) by radiating banks resembling lava-streams, or currents of ejected blocks or scoriæ,[1] evi-

[1] *The* volcanos of Java have all ribbed sides; but these are

lently posterior to the surrounding level; in suggestive ontrast to **120**. I have seen them well about 1^{d} after I. Quarter.

AUTOLYCUS (**84**), its smaller companion, is nearly as deep, vith a similar but less evident radiation. This pair of craters llustrates a not uncommon arrangement, of two rings in the ame meridian; very similar in every respect; if unequal, in liameter as 3 to 4, and the smaller lying S.; from 18 to 36 n. apart; and connected by low ridges running SW.

APENNINES (**85**). This very extensive chain is more like he mountains of the Earth than is usually the case.[1] Its ength, according to Schr., is nearly 460 m., great part of it ying in the next Quadrant. Its SW. side ascends gradually —the opposite aspect breaks down at once in awful preci- ices of stupendous height, casting a shade through 83 m., r losing the last ray as far beyond the terminator. Huy- ens (**90**), the loftiest peak, rises, according to Schr., no bad neasurer, to 21,000 f. B. and M. think he confounded wo adjacent summits, and give 18,000 f.; Schm. prefers 18,500: in any case a superb elevation. On its apex is a ninute crater. Other summits, though inferior, are yet of xtraordinary height and steepness: Hadley (**87**), facing **75**, 15,000 f.—Bradley (**89**) 13,600 f.—Wolf (**92**) 11,000 f. The gradual entrance of the range into sunshine about I. Quarter is a glorious spectacle; and its projection into the lark side, which may be seen without telescopic aid, pro- ably gave rise to the early idea mentioned by Plutarch,

scribed to erosion by torrents. The grand volcano in the island f Luzon ejects red-hot stones forced up over the edges of the crater, nd rolling down amid showers of fire on every side of the cone.

[1] Schm. considers the resemblance not striking, and notes the bsence of depressions similar to terrestrial river-valleys. Ne., owever, asserts the reverse.

that the Moon was mountainous: from its abruptness it does not lose all real shadow till 3^{d} before Full. With very few craters, it consists of ridges and peaks not to be numbered by thousands in large instruments: Schr. detected this; M. says it would take the opportunities of three or four years to delineate all the details which a power of 800 or 1,000 will show.

CLEFT OF HYGINUS. A fine specimen of these furrows lies fortunately in an excellent position in the MARE VAPORUM (L), a tract, of which the dusky streakiness has often interested me about I. Quarter. The cleft is conspicuous enough to yield to a power of 40 in a good telescope, under any illumination. It begins from NE. at the foot of a long low hill, as a flat valley about 1½ m. wide by 9 m. long, where I have found (with 5½ in. aperture) that it receives a branch from E.: having then contracted to about ¾ m. with precipitous sides and great proportionate depth, it passes through 4 minute craters (or, as Ne. and Klein think, mere enlargements), bends a little, receives another short branch from E., and traverses Hyginus (93), but at a lower level, and as a bank. B. and M. once saw, in the wane, its edges bridging the black cavity as two narrow bright lines; and Schm.'s large map represents it so; in this position I have not seen it well, but repeatedly in the increase with 5½ in. achrom. and 9⅓ in. reflect., when the bank appears cut down before reaching the E. side: once I saw the S. of these lines, but cut off at its E. end; at another time the N., perhaps continuous, while a similar line diverged from the same point W. to the NE. side of the crater. A bay at the N. end of 93, shown by L. and G., but missed by B. and M., seems the result of a smaller explosion. This curious spot should be well examined with the most powerful means. B. and M. *describe* and figure a wall to 93; Schr., L., G., and myself

(even with reflector) see none.[1] The cleft then, after touching on 5 very small craters and two broad hills, becomes wider and shallower, and ends after about 106 m. much as it began. S. of this cleft are two small dark spots, one larger, and one of a greenish hue: on the N. side is a region worthy of notice for its change of colour: in Full it is tolerably luminous; at Quadratures, there is near **93** a large blackish spot, covering two ranges of hills and the vale between. Here B. and M., most unprejudiced if not oppositely-prejudiced witnesses, admit a variation of colour not dependent merely on the angle of reflection, and possibly connected with changes like those of our seasons. Of late years a considerable depression, without ring, but full of shadow at the terminator, has become visible in this region, but is of difficult identification without the drawings in the 'Selenographical Journal.' It is called HYGINUS N.

CLEFT OF ARIADÆUS. This, discovered like the preceding by Schr., lies W. of it: it is longer, broader, and probably deeper than its neighbour, with which, as I found, 1866, April 21, it is connected by a branch N. of **102**.[2] It seems to pass under the two mountains nearest its W. end, but others it cleaves visibly, though greatly narrowed by one lofty hill. The accurate L. saw it passing through them all, and traced it for 175 m. I have observed it interrupted, but not exactly as B. and M.: I find it also double for a short distance—two halves not in the same line, with overlapping ends. G. detected a minute prolongation of it far through Mare Tranquillitatis, subsequently seen by Kunowsky, Birt, and Freeman. This and the preceding cleft may be looked for about I. Quarter.

[1] Schm. drew it, and thinks there are no lunar craters without banks. Such 'explosion-craters,' however, exist in Java, the Eifel, and Auvergne.

[2] This was discovered by G.—a difficult object which Klein at times found *invisible, at others* very distinct.

TRIESNECKER (**94**) is surrounded by several minute clefts intersecting and uniting with each other in a manner of which only one other instance is known (near **228**; Schm.)[1] L. detected some of them, but G. drew a surprising number. With $5\frac{1}{2}$ in. I found more than in B. and M.; one cleft double, with overlapping ends. Gaudibert has traced others. E. of this spot L. found some curious streaks and markings believed to be now changed in form.

MANILIUS (**95**), a beautiful cavity, 25 m. in diameter and 7,700 f. deep, has a broad luminous terraced crater- and peak-besprinkled ring. Being visible on the night-side, it was one of Herschel I.'s imaginary volcanos in eruption. Schr. has seen variations, not easily accounted for, in the relative visibility of this and **70** in the earth-shine.

JULIUS CÆSAR (**96**) and BOSCOVICH (**98**) are very dark enclosures, DIONYSIUS (**99**) and SILBERSCHLAG (**101**) very brilliant crater-rings.

Near the two fine craters AGRIPPA (**102**) and GODIN (**103**) (which exemplify the remark under **84**), Schr. once saw for a short time on the dark side, a minute point of light.

RHÆTICUS (**104**), an irregular crater, marks exactly the Moon's Equator, and is one of the few spots to which the Sun and Earth may both be vertical. (See another Rhæticus, in a note on **112**.)

SECOND, OR NORTH-EAST QUADRANT.

SCHRŒTER (**106**). This imperfect crater in an intricate district where the levels are bright, the hills and valleys very dark grey, darkest at Full, is the guide to a remarkable spot a little N., the number on the map standing between the two objects. Here, in 1822, G. discovered the regular formation

[1] The interior of **232** may be added.

which at first attracted so much attention, and subsequently, from the fanciful character of the observer, fell into unmerited oblivion. The object, which he called 'Schröter' (a name transferred by B. and M., when they could not find it, to the nearest crater), and which some have maintained, notwithstanding its size, to be a work of art, is described by him as a collection of dark gigantic ramparts, visible only near the terminator, extending about 23 m. either way, and arranged on each side of a principal meridional rampart in the centre, from which they slope off SE. and SW. respectively, at an angle of 45°, like the ribs of an alder leaf; those to the SW. abutting on a meridional side-wall, beyond which Schwabe and himself subsequently perceived their continuation: frequently, however, traces only of the figure could be discerned, as though it were obscured by clouds: from this cause he supposed it had been quite misrepresented by the careful L., though he had studied it for 6 months: some years afterwards it appeared to have undergone a sudden change, and subsequently G. himself could scarcely make it out on some occasions, though at other times quite distinct: B. and M., notwithstanding great pains, were altogether unsuccessful, till in 1838, subsequently to the date of their map, they surveyed and measured the region with the great Berlin achromatic of $9\frac{6}{10}$ in. aperture; then at last, among a number of curious labyrinthine details, of which their 'Beiträge' contains a view, 5 parallel valleys appeared side by side, each about 9 m. by $3\frac{1}{2}$, sloping all to SW., with prolongations in the same direction, giving very fairly half of G.'s figure—a remarkable attestation from an unfavourable quarter. But he could call many earlier witnesses, having shown it to several German philosophers; Prince Metternich at Vienna found it sooner than any one else from his description, and it was beautifully seen by

Schm. and Schwabe. In England it does not seem to have been looked for, as though to justify G.'s taunt, 'The scientific John Bull here has gone empty away, and behaved himself about it just as his natural disposition led him.' This is, however, no longer true. Knott saw it, 1861, March 19: I caught it with $5\frac{1}{2}$ in. 1862, Feb. 7, a long way from the terminator, which passed through **121**; and could even trace it the next day. I have several times seen it since, but never on, or near, the terminator. It has been finely seen by Whitley, 1870, June 7 and 8; and somewhat differently by Birmingham, 1871, March 29. It is a curious specimen of parallelism, but so coarse as to carry upon the face of it its natural origin, and it can hardly be called a difficult object.[1] A line from **211**, through **106**, carried as far again, finds it a little N. of its place in the map. An interesting drawing by Gaudibert is in *English Mechanic*, 1874, March 13.

Sinus Æstuum (**N**). The absence of even the minutest crater here is remarked as unique: but L. had shown one, and M. subsequently picked out a few with the Dorpat telescope. I have found two easy with $5\frac{1}{2}$ in.

Eratosthenes (**110**) and Stadius (**111**), neighbours, the former more than 37 m. broad, the latter 5 m. broader, connected by a steep mountain of 4,500 f. (higher than any land in the British Isles), are curiously contrasted: **110** has a fine central hill, **111** is nearly level. **110** has a widely-terraced wall of very irregular height; the surrounding ground is also very uneven; so that on E. side it is 16,000 f. above the inner, 7,500 f. above the outer surface; on W. only 10,000 f. and 3,300 f. **111** has such an insignificant ring, about 130 f. high, that B. and M. did not notice it

[1] Birt has referred to a similar formation in Auvergne, described *by Scrope, Extinct Volcanoes of Central France*, 162 (2nd edit.).

till after a three-years' search for *Riccioli's* Stadius, which, being only a spot of local colour, they missed after all.[1] I found, however, little difficulty with this ring. Its interior, as pointed out by Dobie, is curiously speckled, especially S. and W., with minute craters, which have been supposed to be on the increase. Schm. (1849) counted 50, and with the 14 f. Berlin achr. found this region perforated with the minutest craterlets 'like a sieve.' **110** is about as large as the county of Hereford, and lies intermediate between most dissimilar regions. Its Full-Moon aspect is very unlike the description of B. and M., and should be drawn and watched.

COPERNICUS (**112**). One of the grandest craters, 56 m. in diameter. It has a central mountain (2,400 f. Schm.), two of whose 6 heads are conspicuous; and a noble ring composed not only of terraces, but distinct heights separated by ravines: the summit, a narrow ridge, not quite circular, rises 11,000 f. above the bottom—the height of Etna, after which Hevel named it. Schm. gives it nearly 12,800 f. with a peak of 13,500 f. W., and an inclination in some few places of 60°. The shadow of this peak on the E. terraces he once saw reddish-brown and obviously indistinct. Piazzi Smyth observed remarkable resemblances between the conchoidal cliffs of the interior and those of the great crater of Teneriffe. A mass of ridges leans upon the wall, partly concentric, partly radiating; the latter are compared to lava, and the whole is beautifully though anonymously figured in Herschel II.'s 'Outlines of Astronomy.' There is also a much larger drawing by Se.: but this grand object requires, and would well reward, still closer study. It comes into sight a day or two after I. Quarter. Vertical illumination brings out a singular

[1] See next note.

cloud of white streaks related to it as a centre. It is then very brilliant, and Klein remarks that some portions have a bluish tinge. The ring sometimes resembles a string of pearls: B. and M. once counted more than 50 specks. Schm. found the whole neighbourhood, even as far as **144**, studded with the minutest craters. In the direction of **113**, a great number of blackish points come out under a high light; and Klein remarks that processes may be going on there, of which a superficial observation detects nothing.[1]

CRATER-RANGES NEAR COPERNICUS. Between **110** and **112** lies one of the most curious districts in the Moon. Here, in strange contrast with the undisturbed Sinus Æstuum, B. and M. have shown 61 minute craters, believe that more than twice that number might be seen, and question whether any level ground is left: it is pierced 'like a sieve' according to Schm. who reckons about 300. The greater part are arranged in ranges; one row is very evident, where they

[1] To the SW. of **112** Hevel has figured 3 contiguous round dark spots under the name of 'Lacus Herculeus.' Of these the NW. was named by Riccioli 'Dominicus Maria,' the SW. 'Stadius,' and the E. 'Rhæticus.' B. and M., puzzled in identification, owing probably to their being *Full-Moon* markings (though easy ones), dealt summarily with this nomenclature; ignoring Dom. Maria, notwithstanding its claim of neighbourhood to the site **111**; transferring Stadius across it, without any intimation, *per saltum*, to that position; and removing Rhæticus to **104**, at some distance. The latter transposition led to a mistake in the first edition, which Knott has enabled me to rectify. It is this original Rhæticus, not **104**, in which G. discovered one of his curious 'rampart-works:' and I should have given a copy of his figure in *Astr. Jahrb.* 1828, had he not himself condemned it. It was something like his 'Schröter:' a slightly curved line, with a little crater at one end, and a mound at the other, crossed by 4 shorter straight lines. A year later he complained that it had been greatly obscured 'selenospherically,' and *seldom visible*.

stand so close that but for their partitions it would be a cleft, which indeed its N. end resembles. The telescope at Dorpat showed M., after his removal there, great part of the Hyginus cleft as a chain of confluent openings,[1] thus strengthening the idea that these forms may have had a common origin. This region, strangely missed by Schr., was discovered by G., who estimated its minute craters at 400 or 500 f. in diameter; B. and M. give them about 6 times that size. They are easily seen, but the suitable illumination is fugitive: they should be looked for while the Sun is rising on E. side of the wall of **112**.

TOBIAS MAYER (**117**), 9,700 f. deep towards W., has a fine specimen of subsequent eruption by its side.

MILICHIUS (**118**). Remarkably luminous in Full.

MARE IMBRIUM (**O**). The largest of the circular plains, ill-defined E., 5 times as large as M. Crisium: one half dark and flat, the rest very irregular.

ARCHIMEDES (**120**). One of the most regular walled plains, apparently more ancient than the surrounding level, which seems to have nearly filled up its interior, and overflowed the lowest slope of its ring: though 50 m. in diameter, it is depressed only about 650 f.; the wall, averaging 4,200 f. above the interior, carries several towers, the highest nearly 7,400 f. The plain appears smooth as a mirror, according to B. and M., but is divided into 7 nearly parallel stripes of unequal brightness. Observations, however, by Knott in 1860, and Gray in 1880, indicate changes which deserve special attention. There are minute craters in it: G. saw one, Knott 6 or 7. The outer slope of the wall is very complex; a magnificent object against the rising or setting sun.

LA HIRE (**123**), a small solitary mountain 4,900 f. high,

[1] W. of **93** I have, however, seen its bottom apparently quite flat under high illumination, with Bird's 12 in. silvered reflector.

(Schr.) inserted in the map of B. and M., and in the index of their 'Mond,' but strangely omitted in the text. There is nothing striking in its usual appearance, but it was twice seen by Schr. under very different illumination so brilliant as to glitter with rays like a star: he noticed also changes in its form. G. never saw its radiant aspect, and thought its shape entirely altered, and its size reduced, since Schr.'s time. Schm. detected a craterlet on the summit. I once found it on the terminator, $2^d\ 7^h$ after I. Quarter, the brightest object in sight, and radiating as described by Schr. At another time I noticed a similar hill, about $\frac{1}{3}$ of the distance from **122** to **121**, glittering on the terminator like a star with rays.[1] Gerling (1844) found the same phænomenon in a peaked hill on S. side of **80**, and Brodie (1865) close to **149**. I have also seen **131**, and a hill S. of it, very brilliant in the like circumstances. Future observation may decide whether this depends upon a peculiar angle of reflection and vision, or on some changes in a lunar atmosphere; and on this account these objects are especially recommended to the student.

EULER (**125**), 19 m. across and nearly 6,000 f. deep, is conspicuous for its bright streaks.

CARLINI (**128**). In this neighbourhood Williams and two others observed for $1\frac{1}{2}^h$, 1865, Nov. 24, on the dark side, a distinct bright speck like an 8 m^g. star with $4\frac{1}{16}$ in. aperture. This region should be mapped with special care.

HELICON (**129**) and its neighbour Helicon A (now LE VERRIER, **425**) form a curious twin crater, each 13 m. in diameter, and of vast depth. Schr. has given the latter of them 13,600 f.; its complete disappearance in Full,[2] while

[1] This has also been seen by Hunt, 1862.

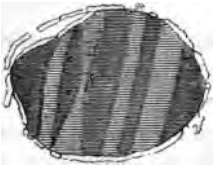
[2] Brodie finds (1865) that this is incorrect, and Gaudibert and *Dennett* have seen **425** the brighter of the two.

129 remains conspicuous, is a striking instance of this peculiarity, and may account for the entire omission of one of them in the maps of Hevel and Riccioli. Did two small craters, on the wall of **129** and the slope of **425**, exist in B. and M.'s time? They are plainer than another which they have given here. I have seen with 9 in. refl. a craterlet in the centre of **129**,—a test-object.

PICO (**131**) is a very fine specimen of an insulated pyramid, rising from a narrow base to 9,600 f. according to Schr., reduced by B. and M. to 7,000 f. (nearer 8,000, Schm.): on any estimate a magnificent sight from the surrounding plain: Schm. however thinks the profile would not be very striking, quite inferior to the steeper of the Swiss Alps, or even the Niesen above the Lake of Thun.—S. of **410**, where that number stands in our Map, is a small crater Pico B. B. and M. show a longish white spot S. of it, which Schm. could never find.

PLATO (**132**). A slight magnifier shows this 'steel-grey' spot, lying as a lagoon at the edge of O, and fore-shortened into an oval, whose proportions vary from (3 to 5) to (4 to 5) in the extremes of N. or S. libration, its distance from the N. limb being in one case half of its amount in the other: such optical variations must always be allowed for in making or comparing delineations of objects not far from the limb. The rampart, not a very connected one, and failing, as Schm. remarks, in terraces, averages 3,800 f. E., something less W., where 3 towers crown it, the loftiest nearly 7,300 f., another somewhat higher bulwark surmounting the E. side (Schm. gives it 9,000 f.). A large winding cleft unnoticed by B. and M. issues from a crater on the W. side, and runs for some distance nearly parallel to the great valley of the Alps. The very level interior, about 60 m. broad, and containing 2,700 square miles, was described by B. and M. as crossed by

4 lighter streaks from N. to S., and containing 3 or 4 specks ranking among the minutest of lunar objects. G. detected 8. The central one is not difficult under a high light, and, with at least 10 others, is evidently a craterlet. Two are quite close, like a double star (Dawes): to which Pratt has added a third. A copy from B. and M.'s map is given here,[1] as the local shading, considered very variable by G., was found greatly changed by me (1855), and is so still. Bianchini, Short, and Elger have seen some longitudinal bright streaks at lunar sunrise. The light-specks have been of late years very carefully studied by Pratt, Gledhill, Elger, and others. By the former observer 37 have been recorded (27 the greatest, 15 the average number at once), as well as 30 or more streaks; and Birt's most accurate comparison of the whole series shows that the visibility of many of them is affected at times by some local cause. The colour also of the interior, unlike almost all other similar spots, is found to darken progressively with the increasing angle of sunshine, and even beyond the lunar noon, as though connected with heat. Klein saw several times in 1878 something like fog in the E. portion.[2] There is a large landslip at SE. end of ring, which Shaler (Cambridge, U. S.) thinks may have resulted from the great changes of temperature, possibly 1,000°, between noon and midnight.



HARPALUS (**133**) has a wall rising 2,800 f. above the plain, nearly 16,000 f. above the chasm below.

SINUS IRIDUM (**P**), styled by B. and M. 'perhaps the most magnificent of all lunar landscapes,' is a dark semi-

[1] These streaks have been omitted in their 2nd edition.

[2] *A similar* observation was made by Ne. and Elger in 1871.

circular bay, level almost as water, wrinkled only by a few slight ridges scarcely exceeding 100 f. and encompassed by abrupt and colossal cliffs, the promontories being upwards of 140 m. apart. The ridge is crowded full of minute, usually round summits, with numberless other objects: the height is not conveniently measurable, but a point by no means the loftiest, W. of SHARP (**139**), reaches about 15,000 f., and the great cape LAPLACE (**134**) rises some 9,000 f. abruptly from the plain. Between it and **132** is a strong NW. parallelism. **P** is in noble projection 2^{d} or 3^{d} after I. Quarter.

KEPLER (**144**), nearly 22 m. in diameter, sinks 10,000 f. in the deepest part beneath a very low bright wall. It is the centre of a great ray-system, connected with that of **112**. G. thought its aspect not always alike in the same illumination.

MARIUS (**147**). The interior of this cavity is both drawn and described by B. and M. as quite uniform. It contains, however, a minute white crater, seen by G. in 1825, and rediscovered by me in 1864, conspicuous in the lunar morning, though invisible in the evening. There is also a trace of some other object. A similar crater E. of the ring is not in Schr.'s figure. More than 100 grey hillocks, the loftiest little exceeding 1,000 f., lie in a narrow space NE. In the plain S. is said to be a most curious winding cleft, like the *cañons* of NW. America.

ARISTARCHUS (**148**). The most brilliant crater in the Moon; quite dazzling in a large telescope, the steep central hill being the most vivid part. The ring is 28 m. across, on W. rising 7,500 f. above its inner, 2,650 f. above its outer foot: on E. it becomes a plateau, which connects it with a smaller and steeper crater, HERODOTUS (**149**). A curious serpentine valley will be noticed here, nowhere exceeding 2½ m. in width (about ⅓ m. deep, Schm.), not unlike a dry river-

bed.[1] The reflective power of **148** is extraordinary, rendering it visible even to the naked eye on the bright side, and with the telescope on the dark : one of Herschel I.'s very few errors was his taking it for a volcano in eruption. Schr. pointed out this, but the mistake has been since repeated by others. There are however, as already mentioned, variations in its light, noticed by Schr., for which Smyth, who has seen it of every size, from a 6 to a 10 m^{g}. star, says it is difficult to account.[2] The bright streaks around it in Full Moon are no more of the nature of lava than they are elsewhere ; but I have seen it on the terminator surrounded by wavy radiating streams. Schm. has repeatedly found the 'nimbus,' or darker space round the wall, of a violet hue, a tint that he has seen also occasionally in the interior of **272** as well as in other places, and which I have independently noticed (1867), at least a bluish glare, under high illumination, near **302** and **325**.[3] About 45 m. WNW. begins a little group of mountains (**490**), the highest nearly 7,800 f. : these coming into light about 3^{d} after I. Quarter are the 'harbingers' of the great spot, conspicuous a day later. Birt remarks that **489**, a mere ring in the map of B. and M., wears a very different aspect now.

HEVEL (**154**), a walled plain 70 m. across, contains a straight ridge, and an extensive convexity of surface ; also a small crater, considered by Schr., but on inadequate ground,

[1] Ne. has seen the high mountain a little way N. of **149** blurred and of a violet tint, when the surrounding objects were all sharp and white.

[2] See p. 76, *antea*.

[3] There could be no suspicion of secondary spectrum, as the reflector was employed. Schm. has sometimes found blue light on the peaks of mountains beyond the terminator, as well as in the interior of **112** and **180**, and in other situations.

to be new. There are some remarkable cross clefts on its floor and W. wall.

ANAXAGORAS (**168**), 31 m. broad, and very white, includes a great mountain not in the middle. It is a streak-centre.

Between TIMÆUS (**170**) and FONTENELLE (**171**) is a good deal of parallelism, and adjoining **171** on W. is one of the most curious instances of it: a nearly square enclosure foreshortened into a lozenge, whose rampart-like boundaries, according to B. and M., 'throw the observer into the highest astonishment.' They are very unequal in height, and one is little more than a light-streak; yet they are so regular that it is scarcely possible to imagine them natural, till we find that they are 64 m. long, 250 to 3,200 f. high, and 1 m. or more thick. There are parallel ridges in the interior, and in one place the form of a perfect cross: unfortunately, it lies in such a position that years, as B. and M. observe, may pass without a good view of it. I have often looked for it in vain. Birmingham has been more successful.

E. of the table-land ROBINSON (**413**), are 3 curious *dark* mountains, about 5,900 f. high.

PYTHAGORAS (**176**) is the deepest walled plain in the Quadrant, nearly 17,000 f. on SE. side.

THIRD, OR SOUTH-EAST QUADRANT.

THIS includes the metropolitan crater of the Moon, TYCHO (**180**), a most perfect specimen of the lunar volcano, visible even to the naked eye in Full, and roughly figured by Galileo in the earliest telescopic representations. Its diameter is 54 m., its depth 17,000 f. or nearly 3 m., so that the summit of our Mont Blanc would drop beneath the ring: the height

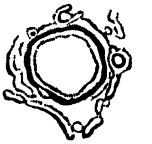
of its fine central hill, 5,000 f.[1] (6,000 Schm.), ranging nearly with the terraces, from 3 to 5 rows of which border the inner slope of the narrow wall. This noble object lies among so many competitors that it is not always immediately identified by an unpractised eye near the terminator, a day or two after I. Quarter; but as the Sun rises higher upon it, its pre-eminence becomes more and more evident. Its vicinity is thronged with hillocks and small craters, so that for a long distance not the smallest level spot can be found; further off, the craters increase, till the whole surface resembles a colossal honeycomb. At **180** commences the largest of the systems of rays, extending over fully ¼ of the visible hemisphere, one ray passing through **H**, almost to the opposite limb. Everywhere the visibility of the streaks is the converse of that of the shadows, so that many great ring-mountains which are overspread by these rays become totally imperceptible under high illumination. In photograms, however, they are less difficult of recognition—a singular fact. The streaks have no connection whatever with the form of the surface, are not in the least elevated or depressed, and resemble nothing on the Earth. In Full the central hill and wall of **180** are brilliant, the interior dark, as well as an exterior zone, beyond which a light cloud forms the base of the streaks. Their appearance reminds me of a vast net gathered up round a circular opening.

HESIODUS (**187**) guides the eye to a cleft E. of it, in the M. NUBIUM (**8**).

[1] A smaller hill close to it on the W. is omitted by B. and M., though readily seen. Birt rediscovered it, but it appears in L.'s map. Gaudibert has detected a curious crevice passing along the inner NE. slope, crossing the crest, and running down the outer SE. face of the wall with a branch inside, and another outside the rampart. Birt had at one time great difficulty in defining the *interior of Tycho*, but subsequently found the mistiness disappear.

CICHUS (189), a crater in table-land, lies 9,000 f. beneath the plateau, 4,000 f. below the plain. In 1833 I perceived that the small crater on its ring was twice as large as it had been represented 3 several times by Schr. On becoming possessed of the map of B. and M., I found it there also enlarged. Schr., though a clumsy, was a faithful draftsman; his views have the appearance of being each independently drawn, and they are under different angles of illumination, which often vary the apparent size of small craters; but, though the characteristic silence of B. and M. may be disregarded, a longer acquaintance with selenography leads to the impression that such evidence of change is of little value. The two figures here given, of which 1 is a copy of Schr.'s design, 1792, Jan. 4, and 2 is taken from B. and M.'s map, may serve as specimens of the respective modes of delineation adopted by these observers.

1



2

LONGOMONTANUS (192). A great ring, 90 m. across, very deep: a peak on W. wall measures nearly 15,000 f. The region is most wild and dislocated. 192, with HEINSIUS (190), a triangle of craters each highest W., as is common here,—and WILHELM I. (191), are admitted by B. and M. to be a little misplaced and out of proportion in their map.

CLAVIUS (193). One of the grandest cavities in the Moon, though ill-placed for observation; tolerably circular, and more than 142 m. broad; it is encompassed by a wall damaged by successive explosions, but still portentously high and steep, attaining 17,300 f. in one of its W. peaks, and covering the gulf with night amid surrounding day. On and within the ring Schm. counts at least 90 craters. 'In

a good telescope,' we are told by B. and M., 'the prospect of a sunrise upon the surface of Clavius is indescribably magnificent.' The shaded side, they justly remark, cannot be in perfect darkness when exposed to the reflection of such an enormous mass of enlightened cliffs. The bottom of the small included crater lying farthest W. falls nearly 24,000 f. below the peak already mentioned—an interval greater than the height of Chimborazo. Well may these observers express their astonishment that of this gigantic bulwark not a trace can be discovered in the Full Moon![1] About 1^{d} after I. Quarter, Schr. remarks that its shadow blunts the S. horn to the naked eye.

MAGINUS (**195**). The ruin of a vast complex ring, with an interior depressed 14,000 f. Some minute hillocks and a little hollow in its centre form a good test. There is an admirable drawing of it in Ne.'s work. The Sun rises grandly upon it a little after I. Quarter, but 'the Full Moon knows no Maginus!' S. of its W. side lies a hollow, the only dark spot under high lights in all this wild region.

SAUSSURE (**196**) bends into a curve one of the streaks of **180**—a solitary instance, or nearly so, of such deviation. W. of it the surface swarms with craterlets, some hardly 0″·5 in diameter.

NASIREDDIN (**198**) and Nasireddin a, just N., are two fine craters; the latter reaches 11,000 f. The former I have often wondered at, about I. Quarter, as the culminating point of immense explosive energy.

The GREAT CRATER-RANGE of the 1st Meridian comprises 5 vast walled plains in almost uninterrupted succession, which, like two other series near each limb, seem to have been formed upon a long cleft running N. and S.: similar vol-

[1] Scarcely to be taken literally, according to Ne.

canic phænomena occur on the Earth—for example, the Andes, and the Puys of Auvergne. The 5 lunar circles greatly resemble each other in character. We begin at the S. end:

1. WALTER (**200**) has lofty peaks on its rampart.

2. PURBACH (**202**) is about 7,500 f. deep. NE. of it, out of the main line, lies

THEBIT (**203**), 32 m. broad, 9,800 f. below one part of its ring. The wall has been pierced by a smaller and deeper crater, against the ring of which a yet lesser mine has been sprung. E. of it we find the

STRAIGHT WALL, a most curious formation, regular enough for a work of art, but more than 60 m. long, and of a very uniform height of about 1,000 f. (880, Schm.). To me it appears brownish. Ne. finds slope exceedingly gradual on W. side, and an irregular 'ditch' all along E. foot. At one end is a small crater; at the other a branching mountain, giving it, as B. and M. say, the appearance of a staff tipped with a stag's horn. It may be well seen from 1^{d} to 2^{d} after I. Quarter, or 1^{d} after III. Quarter. At a short distance E. is a minute cleft of varying breadth and all the character of a river, according to Klein, who considers it a test. We now return to the centre of our series:

3. ARZACHEL (**204**), 65 m. across. On W. side of ring is a peak of 13,600 f. Its neighbour,

ALPETRAGIUS (**205**), is so deep—on W. 12,000 f.—as to be only 5 or 6 days free from shadow. It contains one of the finest central peaks in the Moon—drawn too small by B. and M.—7,000 f. high (Schr.). E. of it, and close to LASSELL (**484**), is a very brilliant little crater, Alpetragius B, 'light-encompassed' like **221**. Farther E. in a line through the S. ring of **205**, and the centre of **484**, is a small round brilliant spot, described and drawn as a crater by B.

and M., but level now. **484** was difficult to them in Full, but easy at present.

4. ALPHONSUS (**207**), 83 m. in diam., has a steep central peak of 3,900 f. (4,500, Schm.), about the height of Vesuvius; under a high light two bright specks, and several defined blackish patches, vary the surface, in those places perfectly level. L. drew 6 dark spots; Schm. found but 3 dark and 1 faint. The latter sees 2 clefts in both **207** and **204**.

5. PTOLEMÆUS (**208**) is the last and largest of the chain: its breadth (over-stated by Schr.) is 115 m.—a magnificent lake, whose surface at sunrise or sunset is occasionally seen all roughened with ridges like waves, not 100 f. high. I have seen the shadows of the W. boundary of it drawn out into bundles of black filaments. Schr. on one occasion drew 4 deep pits in it, 2 of them equal to the obvious small crater: he had never seen them before, and in their position are only 2 minute craterlets now. Schm. gives part of its rampart 12,800 f., and counted, with the Berlin achromatic, at least 46 minute craters in its interior; 12 in E. forming a chain. He also found an innumerable multitude between this spot and **203**.

MŒSTING (**211**) has a vast depth of 7,500 f. beneath a wall only 1,600 f. high on the outside. A minute crater S., Mösting A, is very luminous. HERSCHEL (**212**), 9,500 f. deep, forms with **211** and **94** a triangle marking the Moon's centre.

BULLIALDUS (**213**), a grand crater 38 m. across, 9,000 f. deep, with a quadruple central hill of 3,200 f., bearing, according to Schm., a minute crater-row, is connected by a gorge with a little crater, and is the centre of a remarkable group. I have seen a large radiation round it, as of ejected matter. SW. of it Whitley has discovered several minute crater-chains.

Three walled plains, of which one is PARRY (217), bear evidence of extreme antiquity, and have their rings very curiously split by as many clefts.

EUCLIDES (221) is the best specimen of an infrequent variety, the 'light-encompassed' crater. There are 9 of these—all deep, regular, not large, bright, and closely surrounded by a luminous cloud not resembling the white streaks in character. Four of them lie near

LANDSBERG (222), whose ring of 28 m., with a greatest height of 9,700 f., must command a boundless prospect over the dead level W. of it: it rises very gradually without, but is steep and terraced within.

FLAMSTEED (223) is a crater combined with a circle of banks averaging only 320 f. in height, which is complete in Full, and looks like an overflowed ring.

MARE HUMORUM (T) is a small circular foreshortened plain, about 280 m. across, which may be detected by a keen unaided sight. The greater part is as distinctly green as H, with, in most parts, a narrow grey border. It is sprinkled with innumerable craterlets requiring power and very steady air.

CAMPANUS (226) contains an especially dark centre, and 2 minute craters not in B. and M.; E. of it and W. of HIPPALUS (225) is a most remarkable system of clefts: I have seen 3 readily, 2^d 3^h after I. Quarter.

RAMSDEN (228) is surrounded by a very fine system of branched and intersecting clefts discovered by Schm., having strangely escaped previous notice. In this case the ring-plain seems to have intercepted the clefts.

VITELLO (229) is almost unique in having, within a second concentric rampart, a central peak overlooking the whole ring.

GASSENDI (232), a conspicuous walled plain, 55 m. across, lies considerably higher than the M. Humorum. Its loftiest

point is 9,600 f. above the interior, which contains many minute objects: one little hill shines brilliantly in Full. Schr. noticed several changes here; and there is a strange diversity in the drawings by different hands: but it has recently received much careful study and delineation, and would repay yet more. It must be remembered that its proportions vary considerably according to libration. Many curious clefts may be at times made out in it. Schm. mentions at least 14, Ne. 38. A monograph by the latter is contained in *Astronomical Register*, 1873, May, August, October.

MERSENIUS (**231**) has a convex interior, with several minute craters, hills, and clefts; L. gives but one-craterlet; B. and M. omit everything: Schm.'s drawing is unsatisfactory. This should be well studied. Two little craters, Mersenius B (NE.) and C (NW.) are very luminous. Between **231** and **232** are two clefts, seen plainly by me $4^d\ 3^h$ after I. Quarter.

HAINZEL (**237**) is of great depth and steepness: the ring of CAPUANUS (**238**) is peculiarly irregular in height, and contains at least 7 craterlets.

SCHICKARD (**239**), an enormous plain, exhibiting a fine scene between 4 and 5^d after I. Quarter, is encircled by a complex wall, 460 m. in compass. Chacornac observes, that from the rapid rounding of the lunar globe, a spectator in the centre would think himself in a boundless desert; the ring, though in the N. more than 10,500 f. high, being invisible in every direction. The interior is nearly level, but its colour strongly varied—a curious contrast to the monotony of its neighbour, PHOCYLIDES (**242**). The latter I have frequently seen crossed by a grand shadow from a peak in the ring.

WARGENTIN (**243**) is a singular formation; a circular elevated plain 54 m. across, which, excepting for a very slight

rampart, resembles a large thin cheese. G. and Schwabe have drawn a similar formation N. of it, and E. of **239**.

BAILLY (**245**), like a small sea, lies near the limb; its wall, probably almost as high as that of **193**, seems to run back into the

DŒRFEL MOUNTAINS (**246**), a region of enormous elevation, whose 3 principal summits are occasionally visible in grand profile. B. and M. admit that Schr. did not overestimate them at 25,000 or 26,000 f.

Great craters lie between **242** and S. pole. KIRCHER (**252**) is 18,000 f. deep, among numberless small explosions. CASATUS (**254**) is still deeper; a dome upon its mighty wall rises to about 22,300 f. KLAPROTH (**255**) is a wonder of flatness in these regions.

NEWTON[1] (**256**), an irregular crater, 142 m. long and about half as broad, is the deepest known: the height of its loftiest tower is probably about 23,900 f. above the interior.

MALAPERT (**258**) is the nearest visible crater to S. Pole, 4° of lat. farther, among mountains where the sun never sets.

LEIBNITZ MOUNTAINS (**259**). Ranges of colossal elevation break up the limb here, more than rivalling **246**, and far exceeding anything within the disc: several of the peaks measure nearly 30,000 f.; and Ne. gives a probable height of nearly 36,000 f. to a huge mass, ϵ on his map, lying a little beyond the limb. They extend along a considerable arc of the 3rd and 4th Quadrants. In the crescent their summits frequently prolong the horn; in Full, with suitable libration, they come out in striking projection on the sky,[2] while even

[1] B. and M. transferred this name from a spot so called by Schr. in **0** close to **132**, which they thought unworthy of the designation. There was some inducement in this instance; but the precedent should not be followed, as liable to produce confusion.

[2] We never see a *real* Full Moon; that is, she is never exactly

their apparent bases may lie far above any lunar 'sea.' Their outline is rather rounded: some long ridges may be the profile of great rings. The E. extremity lies in the direction of the bright streak running S. from **180**. I find a clear description and rough measure of them by Cassini, in 1724. Schr., who did not know this, observed them more correctly, and called them the LEIBNITZ MOUNTAINS. By some unwonted inadvertency, B. and M. have interchanged the names of **246** and **259**.[1] Ne. and myself have preferred retaining them as given by the earlier discoverer. These and other ranges sometimes roughen the limb during a solar eclipse, but Schr. found that their peaks then appear much sharper from the irradiation of the Sun.

BLANCANUS (**260**), a noble crater, 51 m. in diameter, with a terraced and turreted ring, domineers 'like Etna over Sicily,' bearing a peak of 18,000 f. above the interior.

SCHEINER (**261**), larger and steeper, includes 10 craters and a partition.

MORETUS (**262**), a very fine object, is 78 m. broad, but of unequal height, 15,000 f. on W. side, widely terraced within, with a bright central hill, the loftiest yet measured,—6,800 f., by which it is easily identified. Its sunrise or sunset is very fine: it may be seen in noble relief about 1^{d} after I. Quarter. I have seen with 9½ in. speculum a very minute crater N. of central mountain.

GRUEMBERGER (**265**) has a central crater, whose bottom is probably more than 20,000 f. below a great peak in the wall.

opposite to the Sun except when centrally eclipsed; hence there is always a small deficiency at one or the other pole; and libration must be favourable, to show these mountains well, and *on a circular limb.*

[1] Their groundless complaint of Schr.'s want of explicitness here shows superficial acquaintance with his work.

ZUPUS (**268**). A valley, very dark in Full. SIRSALIS (**270**), a double ring, W. of which lies a very remarkable cleft, figured by Gaudibert (*Eng. Mech.*, 1873, Dec. 19), with Schm.'s continuation probably more than 400 m. long; the longest known, but requiring favourable libration.

GRIMALDI (**272**). The S. link of a chain of great craters lying in the meridian. This grand spot, 147 m. long by 129 wide, has a darker interior than any portion of the Moon of equal size; it has sometimes been detected even without a telescope. G. perceived here a regular formation somewhat resembling the letter *H* much inclined.

RICCIOLI (**273**) is in part as dark; its ring is grand before the rising or setting Sun.

The CORDILLERAS (**274**) and D'ALEMBERT MOUNTAINS (**275**), a series of great ranges, nearly 20,000 f. in general height,—much higher, according to Schr., in parts,—rise along the E. limb. They extend far S., and this extremity is called the ROOK MOUNTAINS (**276**). Two valleys were discovered by Schr. in profile on this limb, of enormous depth, rivalling the height of the mountains. They have not been found by Ne.

BYRGIUS (**279**) has on its ring a small crater, Byrgius A, remarkably brilliant, and a centre of streaks. NE. of it stands a great mountain, of probably at least 13,000 f.—as high as the Swiss Jungfrau.

FOURTH, OR SOUTH-WEST QUADRANT.

HIPPARCHUS (**288**), 92 m. across, contains all kinds of formations. Schr. has seen the shadow in its interior bordered on SW. by a fringe of fine lines, indicating a row of sharp

and regular pinnacles on the wall. Three small craters, Hipparchus E, G, and C (reckoned towards S.), in and near W. wall, are very bright in Full.

ALBATEGNIUS (**289**). A walled plain, 64 m. wide, very level. Its rampart, 14 to 18 m. broad, has been all torn by explosions; B. and M. counted at least 33 of their results: a peak in NE. attains 15,000 f. Its central hill, piercing a mass of shade, forms a noble spectacle, which I have seen 10^h before I. Quarter. Close on NW. is

HALLEY (**458**), a 21 m. ring. Here, on NW. part of floor, a photogram of 1865 shows a craterlet which Gaudibert could hardly find when he saw another very distinctly SE. not in the photogram, and, as he thinks, of subsequent formation. There are several instances of craters omitted by earlier observers, though now more obvious than others that they have drawn: indications, possibly of modern activity, but certainly of the great advantage of photography, in never missing anything visible at the time.

Craters with irregular walls and very large central mountains bend round from **289** through AIRY (**291**), to LA CAILLE (**292**). This last, with a wall of 9,700 f., is almost level.

WERNER (**295**), 45 m. across, is one of the loftiest rings; its narrow ridge ranging 13,000 f. (the height of the Alpine Eiger) above the depth, and rising on the E. to 16,500 f., nearly 1,000 f. loftier than our Mont Blanc. A spot on the SE. side of it is very bright—another, on the inner slope of the NE. wall, is stated to be as brilliant as **148**, and more luminous than any other part of the Moon; but this 'star-like flashing point,' being only between 4 and 5 m. square, is said to be easily overlooked with low powers. I have several times readily seen it with two achromatics of $3\frac{7}{10}$ in., and powers 75, 80, and 144, but *never of the specified brilliancy*:

and a careful study of it in 1864, with 5½ in., confirmed with a 9 in. mirror in 1871, induces me to believe that *it has faded since the date of B. and M.* The reflector has shown in it a minute black pit (Ne., crater-cone) and very narrow ravine. It is not mentioned by Schr.

ALIACENSIS (**296**) is similar to **295**, but larger.

THEON SEN. (**297**), THEON JUN. (**298**), ALFRAGANUS (**300**), are all luminous.

ABULFEDA (**305**), nearly 40 m. across, and ALMANON (**306**), have their walls united by a row of little craters like a cleft, visible about I. Quarter.

ABENEZRA (**310**) sinks more than 14,500 f. PONS (**313**) has very dark spots in the ring.

ALTAI MOUNTAINS (**315**). This long range (name omitted in B. and M.'s map) is almost the only high ground in this Quadrant undisturbed by eruptive forces. Its rounded summits lie awkwardly for measurement, but seem about 13,000 f. I have often seen the NW. face as a bright line of nearly 280 m. of cliffs, in the increasing Moon.

A group of 3 huge craters follows, forming a wild and gigantic region, very difficult to delineate. The details occupied B. and M. portions of more than 50 nights. It has since been effectively sketched by Phillips.

THEOPHILUS (**319**) is the deepest of all visible craters, if we regard the general line of the ring, which ranges from 14,000 to 18,000 f. above the chasm, with a diameter of 64 m. No scene in the least approaching to it exists on the Earth. The central peak is 5,200 f. high (more than 6,400, Schm., who gives the wall but 3,200 f. outside height, and finds it surrounded by radiating ridges: these I have seen with a 9¾ in. silvered speculum). CYRILLUS (**320**), equally large and terraced, approaches to a square. A small crater, Cyrillus A, on its E. side, is very brilliant. CATHARINA (**321**) is rather

the largest of the three, and more than 16,000 f. deep, but irregular in character. Of this superb cluster, **319** first catches the rising Sun, and I have seen it far beyond the terminator, and even without the telescope, 5^d after New: it is a grand object when filled with night, through which its glittering central peak comes out like a star. A wide valley connecting **320** and **321** is much better represented in the beautiful old map of Tobias Mayer, and by Russell, than by B. and M.

ISIDORUS (**323**) and CAPELLA (**324**) lie side by side, with a peak of more than 13,000 f. between them; a broad cleft cuts down the ring of **324**, open also in another direction. Schr. here saw traces of a line of little confluent craters. Double craters, too numerous not to have some special cause, abound in this region.

CENSORINUS (**325**), a minute crater, with its vicinity is very brilliant in Full.

MESSIER (**327**) and Messier A, a pair of small deep craters, exhibited to B. and M. such an entire similarity in size, form, depth, brightness, and even the position of some peaks upon the rings, that they say it must have been either a wonderful coincidence, or the result of some unknown natural process. This similarity does not now exist, but the evidence of physical change is not satisfactory. Two curious white streaks, slightly divergent, extend from Messier A for a long distance E., forming with the included shade—not always visible according to G.—the picture of a comet's tail. G., who imagined them to be artificial, states that they are totally unlike any other lunar streaks, being composed of a multitude of distinct lines, each possibly consisting of minute points. In consequence of an observation by Schr., who discovered this 'comet,' B. and M. examined the *streaks, and* could scarcely have avoided including the craters,

more than 300 *times*, between 1829 and 1837, without noticing any change. Strange to say, however, G., who frequently examined this region, expressly states that on several occasions in 1824 and 1825 the W. crater was observed less distinct, or much the smaller, and in 1825 extended E. and W.: once only under very high illumination did it appear to surpass its neighbour in size;—as, in fact, Schr. had already drawn it in 1788. And without knowing anything of G's remarks, 1855, Nov. 14, I perceived with my $3\frac{7}{10}$ in. achr. that the E. crater appeared the larger of the two; and 1856, March 11, I found the W. crater not only the lesser, but '*lengthened obviously in an E. and W. direction.*' I have since noted the dissimilarity with larger instruments; and, however difficult to be explained in accordance with B. and M., it is a matter of very easy observation. The figure is taken from a rough sketch, 1857, Feb. 28: the shadow is probably too broad in W. crater, which is that to the left in the inverted diagram. G. also found, on one occasion, the 2 craters not standing as usual in the axis of the tail, but somewhat oblique; and at another time the interior of the W. crater bright, and the wall open E., like a horse-shoe, while the E. crater was perfect and shadowed. Klein twice found the W. ring of the W. crater invisible, and its interior foggily shaded.

GUTTEMBERG (**330**), like many of its neighbours, is pear-shaped. NE. are 3 considerable clefts. E. and S. of it lie the

PYRÉNEES [1] (**331**), two mountain masses, the N. portion 12,000 f. high.

COLOMBO (**333**), a double crater: in the NE. cavity,

[1] This name is omitted in the *Mappa Selenographica*.

Schm. once found a central hill, not seen by B. and M., or L., nor again by himself.

BORDA (**337**) has a lofty range on its W. side; a peak (Borda *a*) lying in the direction of the centre of **340**, rises at one spring 11,000 f., as abrupt as the Alpine Wetterhorn, or the two great Pics du Midi in the terrestrial Pyrenees.

We come now to the last of the 3 great rows of craters lying in the meridian, consisting of the 4 following objects, which must be looked for in the crescent 3^d or 4^d old, or at a shorter interval after Full:—

1. LANGRENUS (**338**) is a superb object under oblique sunshine, with its terraced ring 9,600 f. high, raised in SE. to more than 15,000 f. by Schm., who gives 5,800 f. to its brilliant central hill.

2. VENDELINUS (**339**) is unequal to **338**, though on the Earth it would be esteemed a wonder of magnificence; it contains a very dark speck in Full.

3. PETAVIUS (**340**) is one of the finest spots in the Moon: its grand double rampart, on E. side nearly 11,000 f. high, its terraces, and convex interior with central hill and cleft, compose a magnificent landscape in the lunar morning or evening, entirely vanishing beneath a Sun risen but half-way to the meridian. Gaudibert has drawn it in *Eng. Mechanic*, 1874, May 8. This, as well as **338**, is according to Schm. a centre of radiating ridges, and he finds the E. walls of these 3 great craters, as well as the neighbouring plain, all crowded with craterlets and crater-rows.

4. FURNERIUS (**345**) has a central crater, N. of which I have seen with $5\frac{1}{2}$ in. a bent cleft: the deep little crater Furnerius A at N. end of the wall is, in Full, a brilliant point on a white streak, and with another streak E. of STEVINUS (**344**) identifies this neighbourhood.

(*NW.* of KÆSTNER (**347**), in favourable libration, a large

grey plain comes out from the limb, resembling **A**, and little, if at all, inferior to it in size. It was discovered, drawn, and described by Schr., and named by him Kästner, but strangely overlooked by B. and M., who appropriated his name to a ring (**347**) connected with it. This interesting region has received from the late Dr. Lee the appropriate name of MARE SMYTHII (**424**), in remembrance of one whose services to astronomy would, however, under no circumstances have been forgotten. Its position in mean libration is shown by a shaded space on the limb opposite **W** on the Map.)

(In various parts of the W. limb [I think from 6° to 9°, and from 11½° to 18½° S. lat., and on each side of 52° N. lat.,—towards E. for 10°], very remarkable flattenings are visible in certain states of libration. Those to the S. lie behind **347** and **424**, with which one of them is identified by Ne. They had been in part previously known to Dawes, but were first described by Key, 1863, Sept. 21. Their most striking appearance is very transient.)

WILHELM HUMBOLDT (**352**), one of several huge rings on the limb, shows peaks of 16,000 f. in profile.

STŒFLER (**354**), rising in one part to 12,000 f., has a very level interior, crossed by two of the rays from **180**, and containing at least 16 very minute craters. It is well seen about I. Quarter.

MAUROLYCUS (**358**). A noble walled plain, sure to be found in grand relief about I. Quarter, or 2^{d} before III. Quarter. Its complex rampart is heaved up on E. side to 13,800 f.; on W., though not according to B. and M. quite so lofty, I have often seen it more conspicuous in the increasing Moon; and Schm. gives it here 18,000 f. B. and M. describe the plain as crossed by 12 diverging bright lines in Full.

BACON (**360**) has a peak on E. ring nearly as high as **358**, and on the top of SE. side a row of 5 minute craters.

LINDENAU (**370**), a perfect ring, rises on E. by 4 stages.

PICCOLOMINI (**371**), a noble circle 57 m. in diameter, has a central hill and complex wall, bearing on E. a tower about the height of our Mont Blanc.

FRACASTORIUS (**372**), a partially destroyed ring, which has been seen complete by Birt and Simms, forms a bay of the MARE NECTARIS (**V**): a little crater on E. headland is brilliant in Full. There are good drawings of it in *Eng. Mechanic*, 1873, Jan. 31, Feb. 14, April 11; 1876, June 30.

From W. side of REICHENBACH (**375**) towards RHEITA (**376**) extends one of the gigantic valleys peculiar to this region. **376** has a ring reaching 14,000 f. Close under it, on the side next METIUS (**384**), is another valley 186 m. long, and from 14 to 23 m. wide, bordered by steep walls; in one spot more than 9,000 f. deep. Along W. side of FRAUNHOFER (**377**) is another valley 7 m. wide, which may be traced through **345**, though of very unequal depth, for 212 m.

STEINHEIL (**385**) is probably the deepest of the double rings, in one place sinking to 12,000 f.

VLACQ (**388**), the leader of a colossal group, is 57 m. across.

A little crater E. of NICOLAI (**393**) called Nicolai A, is very bright in Full. Minute insulated craters abound here at the rate of 65,000 for the visible hemisphere.

ZACH (**396**), 13,000 f. deep, is magnificently terraced.

CURTIUS (**404**) has a very complex and unusually steep wall, probably surpassing the elevation of our Chimborazo.

WEBB (**456**) marks very nearly the position of the lunar equator.

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104. Rhæticus
105. Sömmering
106. Schröter
107. Bode
108. Pallas
109. Ukert
110. Eratosthenes
111. Stadius
112. Copernicus
113. Gambart
114. Reinhold
115. Mt. Carpathus
116. Gay Lussac
117. Tobias Mayer
118. Milichius
119. Hortensius
120. Archimedes
121. Timocharis
122. Lambert
123. La Hire
124. Pytheas
125. Euler
126. Diophantus
127. Delisle
128. Carlini
129. Helicon
130. Kirch
131. Pico
132. Plato
133. Harpalus
134. Laplace
135. Heraclides
136. Maupertuis
137. Condamine
138. Bianchini
139. Sharp
140. Mairan
141. Louville
142. Bouguer
143. Encke
144. Kepler
145. Bessarion
146. Reiner
147. Marius
148. Aristarchus
149. Herodotus
150. Wollaston
151. Lichtenberg
152. Harding
153. Lohrmann
154. Hevel
155. Cavalerius
156. Galileo
157. Cardanus
158. Krafft
159. Olbers
160. Vasco de Gama
161. Hercynian Mts.
162. Seleucus
163. Briggs
164. Ulugh Beigh
165. Lavoisier
166. Gérard
167. Repsold
168. Anaxagoras
169. Epigenes
170. Timæus
171. Fontenelle
172. Philolaus
173. Anaximenes
174. Anaximander
175. Horrebow
176. Pythagoras
177. Œnopides
178. Xenophanes
179. Cleostratus
180. Tycho
181. Pictet
182. Street
183. Sasserides
184. Hell
185. Gauricus
186. Pitatus
187. Hesiodus

188. Wurzelbauer
189. Cichus
190. Heinsius
191. Wilhelm I.
192. Longomontanus
193. Clavius
194. Deluc
195. Maginus
196. Saussure
197. Orontius
198. Nasireddin
199. Lexell
200. Walter
201. Regiomontanus
202. Purbach
203. Thebit
204. Arzachel
205. Alpetragius
206. Promontorium Ænarium
207. Alphonsus
208. Ptolemæus
209. Davy
210. Lalande
211. Mösting
212. Herschel
213. Bullialdus
214. Kies
215. Gueriké
216. Lubiniezky
217. Parry
218. Bonpland
219. Fra Mauro
220. Riphæan Mts.
221. Euclides
222. Landsberg
223. Flamsteed
224. Letronne
225. Hippalus
226. Campanus
227. Mercator
228. Ramsden
229. Vitello
230. Doppelmayer
231. Mersenius
232. Gassendi
233. Agatharchides
234. Schiller
235. Bayer
236. Rost
237. Hainzel
238. Capuanus
239. Schickard
240. Drebbel
241. Lehmann
242. Phocylides
243. Wargentin
244. Inghirami
245. Bailly
246. Dörfel Mts.
247. Hausen
248. Segner
249. Weigel
250. Zuchius
251. Bettinus
252. Kircher
253. Wilson
254. Casatus
255. Klaproth
256. Newton
257. Cabeus
258. Malapert
259. Leibnitz Mts.
260. Blancanus
261. Scheiner
262. Moretus
263. Short
264. Cysatus
265. Gruemberger
266. Billy
267. Hansteen
268. Zupus
269. Fontana
270. Sirsalis
271. Damoiseau
272. Grimaldi
273. Riccioli
274. Cordilleras
275. D'Alembert Mts.
276. Rook Mts.
277. Rocca
278. Crüger
279. Byrgius
280. Eichstädt
281. Lagrange
282. Piazzi
283. Bouvard
284. Vieta
285. Fourier
286. Cavendish
287. Réaumur
288. Hipparchus
289. Albategnius
290. Parrot
291. Airy
292. La Caille
293. Playfair
294. Apianus
295. Werner
296. Aliacensis
297. Theon, sen.
298. Theon, jun.
299. Taylor
300. Alfraganus
301. Delambre
302. Kant
303. Dollond
304. Descartes
305. Abulfeda
306. Almamon

307. Tacitus
308. Geber
309. Azophi
310. Abenezra
311. Pontanus
312. Sacrobosco
313. Pons
314. Fermat
315. Altai Mts.
316. Polybius
317. Hypatia
318. Torricelli
319. Theophilus
320. Cyrillus
321. Catharina
322. Beaumont
323. Isidorus
324. Capella
325. Censorinus
326. Taruntius
327. Messier
328. Goclenius
329. Biot
330. Guttemberg
331. Pyrenees
332. Bohnenberger
333. Colombo
334. Magelhaens
335. Cook
336. Santbech
337. Borda
338. Langrenus
339. Vendelinus
340. Petavius
341. Palitzsch
342. Hase
343. Snellius
344. Stevinus
345. Furnerius
346. Maclaurin
347. Kästner
348. Lapeyrouse
349. Ansgarius
350. Behaim
351. Hecatæus
352. Wilhelm Humboldt
353. Legendre
354. Stöfler
355. Licetus
356. Cuvier
357. Clairaut
358. Maurolycus
359. Barocius
360. Bacon
361. Buch
362. Büsching
363. Gemma Frisius
364. Poisson
365. Nonius
366. Fernelius
367. Riccius
368. Rabbi Levi
369. Zagut
370. Lindenau
371. Piccolomini
372. Fracastorius
373. Neander
374. Stiborius
375. Reichenbach
376. Rheita
377. Fraunhofer
378. Vega
379. Marinus
380. Oken
381. Pontécoulant
382. Hanno
383. Fabricius
384. Metius
385. Steinheil
386. Pitiscus
387. Hommel
388. Vlacq
389. Rosenberger
390. Nearchus
391. Hagecius
392. Biela
393. Nicolai
394. Lilius
395. Jacobi
396. Zach
397. Schomberger
398. Boguslawsky
399. Boussingault
400. Mutus
401. Manzinus
402. Pentland
403. Simpelius
404. Curtius
405. Kinau
406. Pingré
407. Chevallier
408. Moigno
409. Peters
410. Teneriffe Mts.
411. Smyth, Piazzi
412. Herschel, J. F. W.
413. Robinson
414. South
415. Babbage
416. Clausius
417. Rosse
418. Cauchy
419. Crozier
420. McClure
421. Bellot
422. Wrottesley
423. Phillips
424. Lubbock

425. Le Verrier
426. Shuckburgh
427. Goldschmidt
428. Kunowsky
429. Struve, Otto
430. Newcomb
431. Gruithuisen
432. Herigonius
433. Lacroix
434. De la Rue
435. Challis
436. Main
437. Adams
438. Wichmann
439. Bond, G. P.
440. Maury
441. Maclear
442. Dawes
443. Cayley
444. Whewell
445. De Morgan
446. Beer
447. Carrington
448. Le Gentil
449. Tannerus
450. Peirce
451. Birt
452. Nicollet
453. Straight Range
454. Chacornac
455. De Vico
456. Webb
457. Hind
458. Halley
459. Faraday
460. Horrocks
461. Huggins
462. Miller
463. Birmingham
464. Ball
465. Bond, W. C.
466. Mädler
467. Argelander
468. Blanchinus
469. Delaunay
470. Faye
471. Donati
472. Alexander
473. Janssen
474. Cassini, J. J.
475. Foucault
476. Lee
477. Piton
478. Herschel, Caroline
479. Brayley
480. Lockyer
481. Daniell
482. Grove
483. Murchison
484. Lassell
485. Hermann
486. Manners
487. Schmidt
488. Secchi
489. Schiaparelli
490. Harbinger Mts.

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(*The Roman Numerals indicate the Quadrant.*)

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MARS.

(Abbreviations, additional.—D., *Dawes;* ♅, *Herschel I.;* H., *Herschel II.;* La., *Lassell;* Se., *Secchi;* Schi., *Schiaparelli.*)

This planet, with a diameter of 4,210 miles, only about twice the size of the Moon, and not much more than half as large as our own globe, is yet peculiarly interesting to us, as presenting the most intelligible features of any object within our reach. In overtaking him about once in two years we find, as he turns to us his broad round face, that his supposed malignant aspect is changed into that of a miniature Earth, which we might, without much extravagance, imagine to be habitable by man. Not every *opposition*, however, as

it is called, admits of an equally near prospect. The orbits of the Earth and Mars are both elliptical, and not fixed with respect to each other, and no two following oppositions happen in the same part of either orbit, so that the most favourable possible juncture, when the Earth is furthest from the Sun and Mars nearest, occurs ordinarily but once in 15 years, when the diameter of Mars, only 13″ in reversed circumstances, may expand to nearly 30″. The presentation in 1892 will be more favourable than any intervening one: every opposition, however, should set the telescope to work; and we will proceed to describe what we may expect to see.

1. The *Phases*. These are not remarkable: in opposition, a full moon rising through ruddy haze, and, with sufficient power, larger than our Moon to the naked eye: in other situations a dull gibbosity, never sinking to quadrature. M. stated at one time, as Schr. had previously done, that this phasis is always narrower than it should be by calculation; but in a subsequent publication the remark is not repeated. Pastorff thought he saw a phosphorescence on the dark part; but this could hardly have been other than a deception.[1]

2. The *Dark Spots*. The disc, when well seen, is usually mapped out in a way which gives at once the impression of land and water, the outlines, under the most favourable circumstances, being extremely sharp:[2] the bright part is orange,—according to Se., sometimes dotted with red, brown, and greenish points; sometimes found by Schi. filled with a complete network of thin lines and minute interspaces: the darker regions, which vary greatly in depth of tone, are

[1] On two occasions Schr. observed a partial flattening of the limb, as on Venus. Schwabe also has seen it.

[2] Se.'s illustration is strikingly expressed: 'è tutto variegato come una carta geografica.'

in places brownish, but more generally of a grey-green,[1] or, according to Se., bluish tint, possessing the aspect of a fluid absorbent of the solar rays. If so,[2] the proportion of land to water is considerably greater on Mars than on the Earth; so that the habitable area may possibly be much more alike than the diameter of the planets. The water, however, if such it be, is everywhere in communication, and long connecting straits are more common than on the Earth. Schi. (1877–8) especially claims to be the discoverer of a multiplicity of dark narrow channels, splitting up the continents into islands: they appear to have been partially seen by others as far back as Dawes; but the observation is of peculiar difficulty, and Green considers some of them to be merely the edges of faint tones, and of very questionable permanency. The dark spots were early seen, and a long series of drawings is extant, from Hooke, Cassini, and Campani, in 1666,[3] to a great number of the first observers of the present day, with some general correspondence,[4] but much difference

[1] H. refers this colour to contrast. Jacob does not detect it. I have seen it with a 9 in. mirror, beautifully blue. The accurate Humboldt has puzzled himself about these colours. (*Cosmos*, iv. 503.)

[2] On one occasion of very fine definition Burton, with 900 on 3 f. Parsonstown refl., found a dusky space composed entirely of exceedingly minute dark dots; Klein has seen something of the same nature, and Pratt has remarked this *stippled* character, and seen glimpses of a structure too complicated and delicate to be reproduced. Frequently 'a broad hazy streak has been, by patient watching for the best moments, resolved into several separate masses of shading enclosing lighter portions full of very delicate markings,' occasionally almost white.

[3] Humboldt, following Delambre, says that Cassini does not seem to have discovered the rotation of the spots till after 1670. He must have overlooked the figures in *Phil. Trans* No. 14. Kaiser has shown, from the MS. Journal of Huygens, that the latter discovered the rotation in 1659.

[4] ♃'s combined figure in *Phil. Trans.*, 1784, if *reversed*, as it

of detail; which seems due in part to differences of telescopes, eyes, climates, and skill in delineation; in part to altered perspective owing to the inclination of the axis,[1] showing us sometimes more of N., sometimes of S. hemisphere; and in part also to changes in the planet's atmosphere. The older observers thought the spots variable: ♅ perhaps took the lead in supposing them to be permanent—an idea which Kunowsky, as late as 1822, fancied was due to himself. Schr.'s work on Mars, the 'Areographische Fragmente,' which was to have contained 224 figures, left in MS. at his death in 1816, has been recently examined by Dr. Terby, of Louvain, to whom the accurate study of this planet is especially indebted. He finds that Schr. considered the dark spots to be clouds, among which he saw many rapid variations. B. and M. took up the subject with great spirit at the peculiarly favourable opposition in 1830, recovered some of Kunowsky's spots, and from their further observations in 1832, 1834, and 1837, though the same hemisphere was not always equally visible, inferred their permanence. M., a little shaken as to this in 1839, retrogrades still further at Dorpat in 1841: the drawings, however, of later observers exhibit substantially many of the same forms, and, notwithstanding numerous discrepancies, there can be no reasonable doubt that the dark spots are really part of the surface. The distant view of the Earth, indeed, might be much of this nature; its features at one time distinct, at another confused or distorted by clouds: besides, one affirmative—the re-appearance of a spot—proves more, where wide-

may have been in engraving, will be not unlike B. and M.'s polar projections.

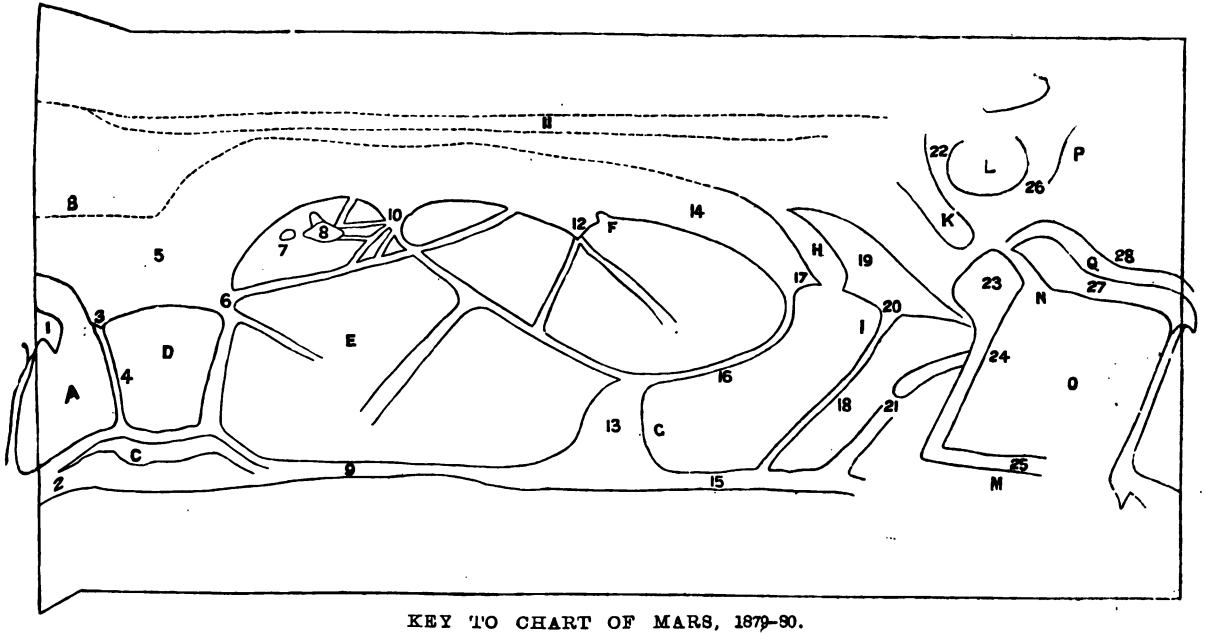
[1] 30° 18′, according to B. and M., and H. But is not this a mistake for the complementary angle? Hind gives, after ♅, 61° 18′ for inclination of axis to orbit of Mars; 59° 42′ for do. to Earth's ecliptic; obliquity on Mars, 28° 42′: but 90° − 59° 42′ = 30° 18′.

spread atmospheric obscuration seems to be frequent, than can be disproved by many negatives. The existing maps of Mars, of which there are several, can only be considered as approximations; nor shall we ever know the N. so well as the S. hemisphere, as it is turned towards us in the planet's aphelion;—even were its markings equally defined, which B. and M. deny. Under favourable circumstances the dusky spots are not difficult objects; I have repeatedly been able to draw them with my $5\frac{1}{2}$ f. achromatic; a much smaller instrument will sometimes show the darker ones plainly; while at other times, and on other parts of the globe, they are feeble even in large telescopes, and for delicate purposes require a long and steady gaze. The presence of haze, or the use of a light screen-glass, may be advantageous with a large aperture in reducing the glare. The motion of the spots will soon be evident, and as the rotation is completed, according to Proctor, in $24^h\ 37^m\ 22{\cdot}735^s$, they will not vary greatly from night to night at the same hour. Most of these remarkable features are represented in a design for which I am indebted to the kindness of Messrs. Burton and Dreyer: this, while free from the conventional hardness that renders the elaborate designs of Schi. so perplexing to the student, resembles in all essential points the beautiful delineation of Green, combining, however, many indications of the curious network of narrow streaks, which the last-named observer considered too uncertain or transitory to be introduced without further confirmation, and the nature and permanence of which will be an interesting object for future investigation by the possessors of adequate optical means.[1]

[1] Green employed, at Madeira, a 13 in. 'With' mirror; Schi., at Milan, a $7\frac{1}{2}$ Merz achr. of great perfection; Burton, in Ireland, a *12 in. mirror* of his own, with smaller instruments.

The nomenclature is at present in a state of confusion, and can only be accepted as provisional, as well as to some extent the representations to which it is applied. The old one of B. and M. was soon found inapplicable, and was superseded by others, based on the names of observers. Of these the most received is that of Proctor, enlarged by Green; but this in turn has been laid aside by Schi. for one founded on ancient geography. Though by no means obtruded by that unpretending observer, it is no doubt better suited to his discoveries; but these, again, though winning their way among very high authorities, have yet to be confirmed and corrected; and in the meanwhile, as ordinary students are not likely to master his finer details, the few names that they will require are derived from Green and Burton, and are given here with a reference chart, to preserve the clearness of the drawing. The land is designated by letters, the water by numbers. The expansion of the polar regions, inseparable from Mercator's projection, must be mentally corrected; and in comparing the portrait with the original the perspective of a sphere must be carefully borne in mind, where the foreshortening is much greater than we are frequently aware of, the eye being probably early biassed by maps of the terrestrial hemisphere in which it is artificially removed.

A. Leverrier Land
B. Jacob Land
C. Rosse Land
D. Mädler Continent
E. Secchi Continent
F. Noble Cape
G. Fontana Land
H. Burckhardt Land
I. Herschel I. Continent
K. Dreyer Island
L. Lockyer Land
M. Laplace Land
N. Banks Cape
O. Beer Continent
P. Kunowsky Land
Q. Phillips Island
1. Dawes's Forked Bay
2. Knobel Sea
3. Burton Bay
4. Dawes Strait
5. De la Rue Ocean
6. Christie Bay
7. Schiaparelli Lake
8. Terby Sea
9. Campani Sea
10. Funchal Bay
11. Maunder Sea
12. Trouvelot Bay
13. Oudemans Sea
14. Maraldi Sea
15. Schröter Sea
16. Huggins Inlet
17. Huggins Bay
18. Gruithuisen Inlet



KEY TO CHART OF MARS, 1879-80.

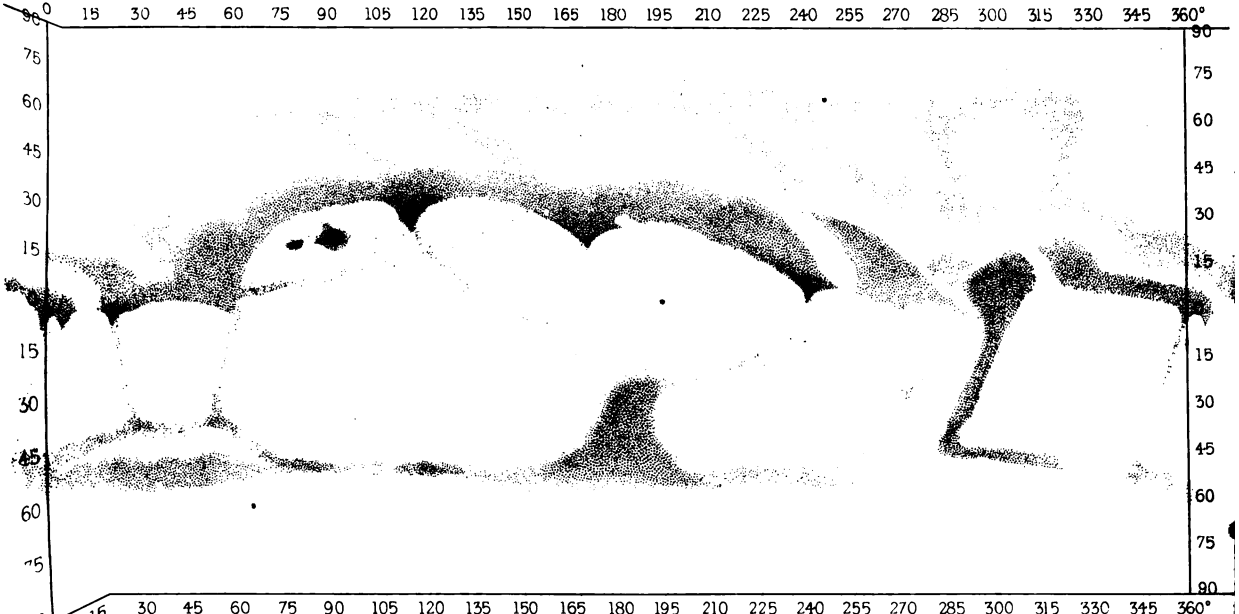


CHART OF MARS 1879-80 — BURTON, SUPPORTED BY DREYER

19. Hook Sea	**23.** Dawes Ocean	**27.** Herschel II. Strait
20. Gruithuisen Bay	**24.** Kaiser Sea	
21. Main Sea	**25.** Nasmyth Inlet	**28.** Arago Strait
22. Zollner Sea	**26.** Lambert Sea	

3. The *Polar Snows.* A spot surrounding either pole is so white and luminous as to have occasionally remained visible when a cloud obscured the planet: and frequently to seem, from irradiation, to project beyond the limb, as I have myself noticed. These zones were figured by Maraldi in 1704, who says they had been occasionally seen for 50 years;[1] in fact, they could not long escape the telescope. They were thought to resemble snow before Ḫ's time; he gave consistency to the idea by ascertaining that they decreased during the summer, and increased during the winter of Mars, and B. and M. have fully confirmed it, with the addition that the S. polar spot has a greater variety of extent, corresponding with its greater variety of climate from the excentricity of the orbit. Each pole comes alternately into sight, and both are sometimes visible on the edge at once, when the opposition of Mars concurs with his equinox. Ḫ found they were not (or not always) opposite each other, both being sometimes in or out of the disc at the same time. M., and Se. with the admirable achromatic at Rome, of $9\frac{6}{10}$ in. aperture and 15 f. focus, bearing ordinarily a power of 1,000, found the N. zone concentric with the axis, but the S. considerably excentric; according to Schi., always 5° or 6° from the pole. It has been suggested by B. and M. that the poles of cold, like those on the Earth, may not coincide with the poles of rotation;—still, one would expect that they might have been diametrically opposite; but in this case, as Schi. remarks,

[1] B. and M. erroneously make him the discoverer in 1716. A figure by Huygens, in 1656, may be meant as a rude representation of them.

the climate may be affected by the position of the neighbouring land. B. and M. found in 1837 the N. pole surrounded by a conspicuous dark zone, the only well-marked spot in sight, which they thought might possibly be a marsh at the edge of the melting snow: in 1839 M. perceived it had decreased; in 1841 it was no longer visible. About the opposition in 1856 I had interesting views of these zones, which did not seem exactly opposite to each other: the S. was surrounded by a very dark region, never seen by B. and M.; on the intervening limbs were occasionally luminous spaces, so bright by contrast as to give the impression of *four* patches of snow, as in one of Cassini's figures in 1666: these were also seen by Se. at the same time. Apr. 4, 1871, Crossley and Gledhill saw a very bright spot on S.W. limb, not far from, and closely resembling, the polar snow. In 1845 Mitchel with a great achromatic in America noticed a very dark spot in the centre of the snow, which disappeared the next night:[1] at another time he saw some movements in a small bright spot at the edge of the snow. Such luminous spots have been seen, though fixed in position, near the pole, by Green. Se. in 1858 found the appearances at the poles irreconcilable with the idea of circular caps, and was forced to adopt the supposition of complicated and lobate forms. Schi. alludes to the possibility of a mass of floating ice.

4. The *Atmosphere.* Such an appendage is implied in the formation of snow, the varying outline or distinctness of the dark spots, their usual disappearance towards the limb, while they can be more readily traced to the terminator, and

[1] D. saw (1847, Nov. 9) a minute black point near the middle of the disc, perhaps the Schiaparelli Lake. Ward has seen (1879, Nov. 22) one of the dark lakes (the *Terby Sea*) as black and defined as the shadow of a satellite on Jupiter, though the general definition on the planet was very bad.

their greater clearness noticed by B. and M., and Lockyer, in the summer than the winter of Mars. Maraldi saw and delineated a dusky belt for a considerable time in 1704; possibly, however, only a bad view of some of the 'seas;' something like it also appears in the designs of Schr., who, from movements in these belts, inferred winds as rapid as our own. Some of Ḫ's figures show white belts, and he says that besides the permanent spots he often noticed occasional changes of partial bright belts, and once a darkish one; we should, however, perhaps, have expected that clouds, viewed from without, would always reflect a brighter light than land or water. Some of the principal continents are occasionally bordered with white, as though snow or clouds were lying on lofty ground; and 'Lockyer Land' has been seen by Schi. (who calls it *Hellas*) nearly as brilliant as the pole. D. has at times noticed changeable white spots: one of these, in the 'De la Rue Ocean,' seen by him 1865, Jan. 21, 22, 23, but invisible 1864, Nov. 10, 12, and looking 'precisely like a large mass of snow,' has been called 'Dawes's Ice Island,' but appears as 'Hall Island' in the map of Green. The same, or more probably a similar one, was seen by me with 9 in. refl. 1871, Apr. 4.[1] Browning frequently noticed in 1867 the transit of faint white spots, becoming, as they neared the limb, almost as brilliant as the polar snows; similar changes were observed by Schi. in 1877. The bright 'menisci' or crescents which some observers have seen illuminating the E. and W. borders of the disc may have had an atmospheric cause, as well as numerous patches of yellow-

[1] 1842, Feb. 3, A.M., rain fell over nearly every part of the United States, from the Gulf of Mexico to beyond Lake Superior, and from the Mississippi to far out in the Atlantic. The upper side of this vast cloud must have appeared as a great white spot if seen at the distance of Mars.

ish and bluish light upon the limb described by M., at Dorpat in 1841, and a bright green patch seen by myself on the E. limb, 1862, Oct. 11. The atmosphere, according to D., is only of moderate density; and seems not to be the cause of the ruddy tinge, as this is most decided in the centre of the disc, while in 1864 he noticed patches of greenish light near the limb. Huggins has also found the planet reddest when its atmosphere was clearest, and remarks that the colour does not affect the snow. His spectroscope showed a vaporous envelope similar to, but probably not identical with, our own: Janssen's and Vogel's indicate aqueous vapour. Cassini, and in this century Tralles, exceeded all bounds in supposing that the atmosphere could obscure small stars at some distance; this effect, resulting from the contraction of the pupil in a bright light, was imperceptible in the great telescopes of ♅, and the idea has been overthrown by the experience of South, who has seen one contact and two occultations of stars without change: in the last, his great achromatic (now at the Dublin observatory), $11\frac{7}{8}$ in. aperture and nearly 19 f. focus, actually showed the star neatly dichotomised in emerging. This is not surprising, for the atmosphere, if in proportion to ours, would not extend $0''.4$ beyond the limb when nearest to the Earth.—♅ ascribed a great ellipticity ($\frac{1}{16}$) to this planetary globe; D. could detect none; Schr. made it less than $\frac{1}{81}$; Hartwig gives it $\frac{1}{250}$.

5. The *Satellites*, one of the most unexpected of modern announcements, are not so utterly out of place in a work like the present as might be supposed from their tardy discovery. Deimos, the outermost, has been seen by Pratt, with an $8\frac{1}{7}$ in. 'With' refl. Erck has seen it with $7\frac{1}{8}$ in. achr., and Common believes that whoever sees Enceladus may catch both by hiding the planet; of course at or near *their elong*ations: moonlight being no disadvantage. At

Harvard Observatory Deimos is thought to be brightening, especially E. of Mars. Its diameter is supposed to be 6, that of Phobos 7 miles.

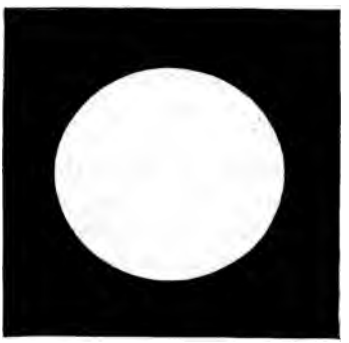
The MINOR PLANETS hardly come within the design of these pages, though the more conspicuous of them may sometimes be found by the 'Nautical Almanac' with little trouble, and Vesta, when nearest to us, is visible to the naked eye. But any investigation respecting the discs, supposed nebulous envelopes, and variable light of a few of these extremely minute bodies, belongs only to first-rate instruments.

JUPITER.

THIS magnificent planet is an excellent object, in view for months together, and for some part of every year, shining with a brilliancy which near opposition casts shadows in a darkened room, and in the Earl of Rosse's reflector has been compared to that of a coach-lamp;[1] it is attended, too, by a most interesting retinue. In the latter even a very moderate telescope will show one of the most diversified scenes in the heavens. Not only from night to night, but often from hour to hour, incessant changes will catch the eye; and since the orbits of all the satellites lie nearly edgeways with respect to the Earth, the retreating and advancing motions appear to intersect one another, and these miniature planets are seen overtaking, passing, meeting, hiding, and receding from one another in most beautiful and endless mazes. We begin with the features of the globe.

[1] Bond II. has often seen it with the naked eye in high and clear sunshine: so Denning occasionally; and it is recorded of Horrocks and Humboldt.

1. The *Ellipticity.* No heavenly body (except at times Venus) shows a disc so readily as Jupiter; a very low power will bring out his noble face, 87,900 miles in diameter, or 11 times larger than our Earth; and with higher magnifiers we shall soon perceive that it is not circular, but a little flattened N. and S.[1] Obvious as this is, it was doubted at one time by Cassini, and missed by Hooke, though he drew the spots of Mars, and directed particular attention to the polar flattening of the Earth. Astronomers differ as to its amount; from many comparisons and observations Main fixed it at a little more than $\frac{1}{17}$ of the equatorial diameter; Se. gives $\frac{1}{16}$; Engelmann, from a mean of 11 observers, $\frac{1}{15 \cdot 82}$. Once noticed, it is so evident that a correct eye will not tolerate the circular figures too often used to represent this planet; and the student who wishes to draw the belts should prepare



oval discs beforehand, which may be done thus: Make a rectangle 15 high, 16 wide, on any convenient scale of equal parts; find its centre by intersecting diagonals; from this describe a circle touching the top and bottom, and then *pull out* as it were the sides of the circle to touch the ends of the rectangle, altering the curves by eye and hand till a tolerable ellipsis is produced: if many discs are wanted, cut one out

[1] The beginner may be reminded that the points of the celestial compass only stand straight when the object is on the meridian; but at all times they may be verified by recollecting that the motion *through the* field is always from E. to W.

neatly in card, and draw the others by means of its edge. The accompanying diagram may assist the process.

On one occasion Schr. perceived a local flattening near the S. pole, which was confirmed by other eyes and instruments, but never returned; an appearance similar to what he noted in Mars and Venus. Birmingham and myself have seen the limb deceptively flattened by the close proximity of a satellite.

2. The *Phasis*. The orbit of Jupiter is so far external to that of the Earth that there can be but little defalcation of light—ordinary books say *none*: a diminished breadth is, however, measurable, if not visible, in our best instruments, and a moderate telescope will show the *approach* of the gibbous form about the time of Jupiter's quadrature, in a slight shade along the limb furthest from the Sun. This was recorded by myself as far back as 1838, May 30, but I believe I had seen it previously, as often since, with the $5\frac{1}{2}$ f. achromatic: more recently, De la Rue, Se., and others have mentioned it. I have thought it plainer in twilight than darkness; a fact in accordance with many similar observations by eminent astronomers.[1] At Adelaide (S. Australia), II and III have been seen with an 8 in. achr. to emerge, in consequence of phasis, at a sensible distance from the limb.

3. The *Belts and Spots*. Grey streaks across the disc, unnoticed by Galileo, perhaps from their occasional faintness, were soon detected by Torricelli, and by Zucchi in 1630; and it would be found that, though always lying in one equatorial direction, they were not permanent in position, but subject

[1] The most perfect telescopic vision is sometimes attained under unlikely circumstances—such as fog, twilight, and moonlight: every object is best seen under certain proportions of light and power and contrast, which are matter of experience; and in such experience lies much of the observer's skill.

to sometimes very gradual, sometimes very rapid changes, which, when we bear in mind the size of the planet, must often be on an enormous scale. The equator is frequently luminous, having on each side of it a broad dusky streak, beyond which a series of apparently narrower stripes extend to either pole. Here, however, perspective must be taken into account. The planet appears so like a flat disc that we easily become unmindful of the spherical foreshortening in every direction, counterbalanced, indeed, in its effect near the equator by rotation, but irremediable towards either pole, where large tracts must ever remain almost unknown. Inattention to this material point would be, and probably has been, the cause of much unsatisfactory delineation. We can easily perceive, however, that the visible arrangement of details is very uncertain in all respects except that of a general E. and W. direction; oblique,[1] curved, or ragged streaks are sometimes seen, and dark spots of various sizes; and the belts are often interrupted, as well as varied by notched or wavy outlines: but Green remarks that the masses of dark and light, large or small, usually balance one another on the whole. Occasionally the belts throw out dusky loops or festoons, whose elliptical interiors, arranged lengthways, and sometimes with great regularity, have the aspect of a girdle of luminous egg-shaped clouds surrounding the globe. These oval forms, which were very conspicuous in the equatorial zone (as the interval of the belts may be termed) in 1869–70, have been seen in other regions of the planet, and are probably of frequent recurrence. Their outlines were seen jagged in the great achr. at Bothkamp. The

[1] The change of inclination in one of these oblique belts in 1860 was very remarkable, and might be supposed to indicate that the atmosphere revolved faster at the equator than at some distance of N. latitude (*Monthly Notices*, xx. 243).

earliest distinct representation of them is said to be that by G. in 1838, followed by Lassell, 1850, and D., 1851, Mar. 8; but they are perhaps indicated in drawings of the last century. It is by no means easy to assign a reason for this prevalent configuration, which sometimes shows itself in a solitary ellipse (Gledhill and Mayer, 1869–70; Gledhill again, 1871). Schwabe has observed the whole disc traversed by minute parallel dark lines, most distinct in the dusky belts, where also they have been recognised by the Earl of Rosse, Jacob, and Burton. According to Schwabe the belts fade off by the formation of longish white spots, or bays, and return by a similar process; and in either case the two principal streaks frequently show corresponding patches. The edges nearest the equator are usually the darkest and most permanent parts. The larger belts, especially, have at times a brownish, coppery, or purple hue: Se. (1860) calls the principal belt red, with other alternate bands of green and white; but the more luminous equator sometimes exhibits a remarkable ruddy, yellow, or brown tint: this, which had formerly been noticed by ♅ (1790) and probably by G. (1834?), was seen by Prof. Herschel in 1860, Carpenter in 1861–2, and has been frequently remarked since 1869. In 1870 Lord Rosse found it so conspicuous as to affect the whole colour to the naked eye. Burton could not trace it, however, in 1873. Airy and Browning suspect a periodical return. Generally speaking, there is often 'something rich and strange' in the colouring of the disc. Lord Rosse describes yellow, brick-red, bluish, and even full-blue markings; Hirst, a belt edged with crimson lake; Miss Hirst, a small sea-green patch near one of the poles: and the great red spot of 1879 is still as conspicuous as ever. Such spots are not uncommon, though seldom of so decided a hue. They are occasionally luminous, more frequently very dark: one

of the latter, seen by Hooke in 1664, and Cassini in 1665, was unusually permanent, having been observed, with many interruptions, till 1715; it even seems to have reappeared as late as 1834,[1] always with the S. equatorial belt, though the belt has often been seen without it. G. once (1822) saw and drew a small elliptical black speck close to the limb near the S. pole. An observation by South affords a beautiful illustration of the evanescent nature of some of these objects. 'On June 3, 1839, at 13^h 45^m (sidereal time) I saw with my large achromatic, immediately below the lowest [? edge] of the principal belt of Jupiter, a spot larger than I had seen before: it was of a dark colour, but certainly not absolutely black. I estimated it at a fourth of the planet's equatorial diameter. I shewed it to some gentlemen who were present: its enormous extent was such that on my wishing to have a portrait of it, one of the gentlemen, who was a good draftsman, kindly undertook to draw me one: whilst I, on the other hand, extremely desirous that its actual magnitude should not rest on estimation, proposed, on account of the scandalous unsteadiness of the large instrument, to measure it tricometrically (*sic*) with my 5 f. equatorial. Having obtained for my companion the necessary drawing instruments, I went to work, he preparing himself to commence his; on my looking however into the telescope of the 5 f. equatorial, at 13^h 45^m (*sic*), I was astonished to find that the large dark spot, except at its eastern and western extremities, had become much whiter than any of the other parts of the planet, and at 14^h 19^m

[1] According to Hind, however, these spots were on opposite sides of the equator. The spot, or rather spots, of 1834 had been seen by Schwabe in 1828, and by myself with a fluid achromatic in 1831 and 1832. D. observed a very large black spot in 1843. Two *were visible* at the close of 1858.

these miserable scraps were the only remains of a spot which, but a few minutes before, had extended over at least 22,000 miles.' The speedy resolution of a spot into minute points was once noticed by Schwabe, who also found that the large spots were composed of smaller masses, surrounded in one case by a general penumbra, like a sun-spot. A very different kind of spots has recently been observed—minute white roundish specks, about the size of satellites, on the dark S. belts. D. first saw them in 1849, Lassell in 1850, with his Newtonian reflector, of 2 f. aperture, 20 f. focus. D. has since given several striking drawings of them in the 'Monthly Notices of the Astronomical Society,' and they have been subsequently seen by many observers. They are evidently not permanent. Common telescopes will have little chance with them, or with the similar traces which Lassell has detected (1858) on the bright belts. All these phænomena prove the existence of an envelope like that of the Earth in instability,[1] without, however, necessarily inferring (as has been done) perturbation by tempestuous winds: even in our own atmosphere, when near the 'dew point,' or limit of saturation with moisture, surprising changes sometimes occur very quietly; a cloud-bank observed by H., 1827, Apr. 19, was precipitated so rapidly that it crossed the whole sky from E. to W. at the rate of at least 300 miles per hour; and alterations far more sudden are conceivable where everything is on a gigantic scale. The ancient astronomers soon recognised the signs of an atmosphere, and Huygens speaks of clouds and winds on Jupiter; but they seem to have looked upon the dark as the cloudy

[1] The spectroscopes of Huggins, Buckingham, Le Sueur, and Vogel indicate an atmosphere similar to, but not identical with, our own. Water could not exist there in a state of fluid or vapour, except on the supposition of internal heat.

belts, forgetting that to an eye placed *above them*, vapours in sunshine would appear whiter than the globe beneath. Schr. made the same mistake, and ♅ for a time, though subsequently he perceived the probability that the dusky belts may be the real body of the planet. This is supposed to be established by the invisibility of the darkest spots when near the limbs, and the fading away of the grey streaks towards their ends; but the argument is not conclusive: in the former case sufficient allowance may not have been made for foreshortening; and the great red spot is seen on the limb: the latter phænomenon is less evident than has been sometimes stated; it is not mentioned by ♅, though described and represented by his son: greatly exaggerated in the clumsy figures of B. and M., it does not appear in the elaborate design of De la Rue: it comes out in Lohse's drawings at Bothkamp with the 11½ in. achr.; in fine air it is questionable with my 9⅓ in. mirror. Burton with 12 in. finds the darker belts enfeebled only, the faint stripes effaced near the limb. However, it may be admitted as the likelier alternative that what we call clouds are the more reflective portion of the disc. That the atmosphere does not extend far enough beyond the limb to affect the brightness or motion of the satellites in passing behind the disc, was proved by D. with his 'solar eye-piece,' and theory demands great thinness for an envelope exposed to such powerful central attraction; but we have very little knowledge of the true constitution of the apparent surface. Terrestrial analogies will be found feeble in proportion as they are pressed. Vapours like our own would reflect no such variety of colour; and the very inferior density of the planet, only ¼ that of the Earth, may well lead us to anticipate startling discrepancies. The equatorial direction of the streaks, and the swift rotation of *the globe*, appear to be connected, though in what manner it

is not easy to explain, as the analogy of our trade-winds will be found insufficient; but the general aspect cannot be mistaken; and Piazzi Smyth, in his charming book, 'Teneriffe,' has described in the most graphic manner the appearance of 'a windy sky' and the shapes of drifting and changing vapours, 'most picturesque clouds,' seen with a $7\frac{1}{4}$ in. achr. on 'the peak of Teyde,' and beautifully delineated in his more scientific 'Report.' The great dark spots possess more stability, as though some portions of the surface cleared the sky above them for a considerable time; yet these, or rather the vapours around them, are liable to displacement, and do not always give the same period of rotation. This, however, appears to be very nearly $9^h\ 55^m\ 27{\cdot}48^s$ for day and night;[1] so that the equator of this huge globe is flying 28,000 miles an hour, or between 7 and 8 miles every second! and a few minutes show the movement of the spots, but puzzle the draftsman. We must now proceed to

The Satellites.

Are these little moons visible to the naked eye? The question has been usually negatived, as, though I (*i.e.* the first, or nearest) is about as far from Jupiter's surface as our Moon from the Earth, they are very minute, and overpowered by the planet's rays. Yet there have been exceptions. Benzenberg speaks of 16 correct observations by 3 independent observers. A tailor, named Schön, at Breslau, who died in 1837, always and indisputably perceived I and III, when sufficiently distant from Jupiter. The Marquis of Ormonde is said to have seen them in the sky of Etna;

[1] Airy, from Cambridge observations in 1834, makes it $6{\cdot}5^s$ less. Schmidt finds it different from dark and light spots. His mean, 1873, is $9^h\ 56^m\ 7{\cdot}2^s$. Cassini had thought that bright spots rotated more rapidly near the equator.

Jacob and another have made out III at Madras: the missionary Stoddart at Oroomiah, in Persia, states that he could detect some of them in twilight, before the glare of the planet came out; and under the same circumstances two are said to have been more recently perceived by several persons at Devizes.[1] The keen eye of Heis could occasionally see two when close together. Once (1832, Sept. 1), III and IV being on the same side, and far from Jupiter, I saw them, though not separately, through the concave eye-glass which corrects my near sight: so Denning, separate, 1874. Levander saw I, 1859; officers of the 'Ajax,' II and III, 1860. Banks has seen I and II as one; III often, and once a glimpse of IV. II and III were seen separately by Boyd, 1860; I, II, IV as one by Todd (U.S.A.), 1874. Mason saw III, 1863. Buffham has frequently detected it. To try this experiment, the planet had better be just hid behind some object, though I did not find it necessary. Any small telescope will bring them out, and a powerful instrument shows them even in the day time.[2] Like Galileo, we may not at first perceive all 4, as some are often invisible before or behind Jupiter, or in his shadow; and this happened to them all, 1681, Nov. 2; 1802, May 23; 1826, Apr. 15; 1843, Sept. 27; but we shall soon recognise the whole train, and must attend to the following particulars.

1. Their *Identification*, a matter of some importance. III, if well situated, is usually brightest at first sight. IV goes much further than the others; but the best way is to consult the daily configurations in the 'Nautical Almanac,' attending to the explanation of the symbols.

[1] This occurred about 20^{m} before a remarkable crimson aurora. 1859, Apr. 21. Compare the observation of Venus, p. 57. ♅ found *no* perceptible effect on stars from auroral light.

[2] *Grover* has seen III, 45^{m} before sunset, with only 2 in.

2. Their *Magnitudes*. Even a small instrument will show that their light is steadier than that of stars; this arises from their possessing real discs, which will soon be 'raised' or drawn out, with increase of aperture and power; and beautiful miniature full moons they will be found to be, by no means, however, of one size. Engelmann, as a mean from various observers, gives I, 1″·081; II, 0″·910; III, 1″·537; IV, 1″·282,[1] corresponding respectively to about 2,500, 2,100, 3,550, and 2,960 miles. This accounts in part for their different brightness, but a difference of reflective power (*albedo*) must be combined with it in the general effect; and the individual light of each varies at different times. From many comparisons Hl and Schr. considered that, like our Moon, they always turn the same side to their primary, and consequently different faces—some of which may be darkened by spots—to us: this has been confirmed by B. and M., but is still an inadequate explanation; its results are not always uniform, and singular anomalies occur, especially with IV. As far back as 1707 Maraldi noticed that, though usually faintest, it was sometimes brightest (a variation which he ascribes to all the satellites), as Klein has seen it at the present day; in 1711 Bianchini and another once saw it for more than 1^{h} so feeble that it could hardly be perceived; 1849, June 13, La. made a similar observation with far superior means; Key once found it very small and obscure for at least 48^{h}, and T. T. Smith and Denning have noticed extraordinary faintness. III is more

[1] Se. made them 0″·985, 1″·054, 1″·609, 1″·496; but the first two measures were due to a single day: this anomaly will be again mentioned. With the Chicago 18½ in. achr. they have been measured 1″·114, 0″·980, 1″·778, 1″·457. The measures and the magnitudes deduced from them will all be a little too large from the effect of irradiation.

consistent, usually taking the lead, yet Maraldi and Bond have sometimes observed the contrary; and many years ago, when I paid some attention to this subject, I have seen it repeatedly surpassed by IV. Engelmann thinks that, as a mean, II is relatively the most, IV the least, luminous. In studying these changes we should hide the planet behind a narrow bar in the field, made by placing a thick wire, or strip of metal, or wood, or card, across the opening in the diaphragm between the lenses of a Huygenian eye-piece; it is also advantageous to throw the satellites a little out of focus, in order to *eliminate*, as mathematicians say, or get rid of, the impression of size, which might mislead the eye. ♅ used a convenient mode of expressing differences of light by stops of different value; thus III : I=II, IV would signify that III was very much brighter than I and II, and both these again a very little brighter than IV. Employing this notation, Denning, from a long series of observations in 1879, gives the mean relative brightness III; I, II, IV: reflective power II, I, III; IV : variability IV; II=I, III. He thinks III is growing much darker and more variable, IV slowly brighter. The distances from Jupiter must be estimated in diameters of his disc, and the direction of each satellite's motion noted, to avoid confusing the near and remote halves of its orbit. The approximate periods here given will be of use—I, $1^d\ 18^h\ 28^m$; II, $3^d\ 13^h\ 15^m$; III, $7^d\ 3^h\ 43^m$; IV, $16^d\ 16^h\ 32^m$. Spots, as we shall presently see, may easily cause this variable light: but a stranger anomaly has been perceived; the discs themselves do not always appear of the same size or form. ♅ noticed the former fact and inferred the latter; and both have been since confirmed by others. B. and M., La., Se., and Buffham have sometimes seen the disc of II larger than I, and La., Se. and *his assistant*, and Burton have distinctly seen that of III

irregular and elliptical; and according to the Roman observers, the ellipse does not always lie the same way; Mitchel also, with 11 in. achr., has observed this disc irregular and hazy. Buffham has often found IV the smallest of all, and irregular-looking. Phænomena so minute hardly find a suitable place in these pages, but they seem too singular to be omitted; and in some cases possibly small instruments may indicate them; at least, with an inferior fluid achr. reduced to 3 in. aperture I have sometimes noticed differences in the size of the discs which I thought were not imaginary.

3. Their *Colours*. Different eyes and instruments have here given different results. H makes I and III white, II bluish or ash-coloured, IV dusky and ruddy. B. and M. call I rather bluish, II and III yellowish, IV always bluish. Se. finds III sometimes whitish, generally red. Engelmann states that III is intensely yellow with low powers, and IV in achromatics a distinct dusky blue: but D. considered IV ruddy, as I have often thought; especially with 9 in. mirror. One unfavourable night of very thin white haze (1832, Oct. 8) I found with $3\frac{7}{10}$ in. the colours of II, III, and IV unusually contrasted, though the discs were not well seen. Many times, both with the fluid and the $5\frac{1}{2}$ f. achr., I used to fancy IV, when distant from Jupiter, and especially when viewed obliquely, encompassed with a little scattered nebulous light: but I have been unable to confirm this with better instruments. It certainly is very unlike III when they are near together; but the difference perhaps arises from colour. The spectroscope of Vogel gives indications of atmospheres.

4. Their *Eclipses*. The fading away or breaking forth of these little attendants, as they pass into or out of the great cone of shade which their monarch casts behind him for half a hundred millions of miles, is always interesting, and, when

not too near the primary, within the reach of moderate instruments. The time being taken from the almanac, long enough beforehand to be quietly prepared with the most suitable eye-piece, a sharp look-out must be kept, as the diminution or increase of light, though not instantaneous, is speedy, especially with I and II. The planet had better be concealed behind a bar. Both Immersion and Emersion may be seen of III and IV, if not too near opposition; this can seldom be done with II (four instances only are on record), never with I, as the disc of the primary interferes. As the planes of their orbits pass so nearly through the Sun and our eyes, it seems remarkable that though respective occultations have been seen, there is only one recorded instance of the eclipse of one satellite by the shadow of another.

5. Their *Occultations* by the globe of Jupiter: frequent, but not usually of much interest, as they show no effect of the planet's atmosphere. Occasionally, however, singular appearances have been noticed. Schumacher once saw a satellite hang on the limb, and seem to recede again, or make an indentation in it; Gorton, 1863, Apr. 26, found that II appeared and disappeared several times before occultation, perhaps from unsteady air; but at the same time Wray, with an 8 in. object-glass, saw it projected distinctly within the limb for nearly 20". 1857, Jan. 3, Hodgson saw I projected on the disc for nearly 1^m with clear space round it. Carlisle, at Stonyhurst, saw II within the limb for about 45" after last contact in occultation, 1878, Sept. 20; and in the same year Todd and Ringwood at Adelaide observed, with an 8 in. achr. and splendid definition, 3 certain and 2 doubtful cases of projection of I and II, as though seen 'through the edge of the disc.' We are at once reminded of the projection of stars on the Moon; but all such anomalies are *worth recording*. Todd says that the satellites are visible

through the dusky, hidden by the bright, parts of the limb; but this might result from projection on a different background. Ne. is of opinion that they are seen through a spurious limb produced by irradiation, and extending perhaps 0″.5 beyond the true. A very singular occurrence was observed at Melbourne, 1879, Sept. 14:—the occultation of the star **64** *Aquarii*, which in the great reflector occupied about 35ˢ in disappearing, and could still be traced for 10ˢ longer 'as a speck of light seen through ground glass: this also disappeared gradually;' it may be a question whether through the irradiation-limb or the atmosphere.

6. Their *Transits*. The most beautiful phænomena of this beautiful system; often recurring, and not too difficult for a moderate telescope: the first known instance having been seen as early as 1658, with one of the old unwieldy refractors, by its skilful maker Campani, and my fluid achr. of 3 in. aperture having often given me a pleasing view of the scene. When a satellite is seen rapidly approaching Jupiter, on the *f* side (that is, the side *following* as the object passes through the field), a transit is inevitable; the satellite will glide on to the disc like a brilliant bead, and remain visible from its greater brightness for some distance—according to South, $\frac{1}{6}$ or $\frac{1}{8}$ of Jupiter's diameter—till it is lost in the luminous background, to reappear after a time, and pass off in the same manner: or, if it traverses a dark belt, it may be perceptible throughout. But this is not all. An astronomer on Venus might witness a similar transit of our Moon across the Earth at the time of one of our solar eclipses, but he could scarcely if at all perceive the black dot of shade which our attendant casts upon us, as, from our comparative nearness to the Sun and the breadth of his disc, the cone of lunar shadow tapers so rapidly that its end falls short of the Earth in annular eclipses, and in total ones

covers so small a spot on the surface that it would be invisible at any considerable distance,[1] notwithstanding the expansion due to the 'penumbra' or border of fainter shade extending over the region where the Sun's disc would be deeply but not entirely obscured. But Jupiter is so much further from the Sun that the shadows of his satellites form much longer cones, and falling little diminished upon his disc, traverse it as singular and conspicuous objects, perfectly round and as black as ink, at varying distances *p* or *f* (that is, preceding or following the satellites), according to the relative positions of the Sun, Earth, and Jupiter. At opposition I has been seen projected on its shadow, which, enlarged by penumbra, appeared as a dark ring. The sharpness with which the entrance of the shadow can be traced has been pointed out by Klein as a good test of defining power in a telescope. When not near opposition, the shadow, especially of III or IV, may be far within the disc, while the satellite shines out in the dark sky. Occasionally two of

[1] The greater axis of the elliptical dark spot (neglecting the penumbra) which traversed England (very nearly in the course of the annular eclipse of 1858) during the last total eclipse, 1715, Apr. 22, is given at 150 miles, from Dartford to Oswestry, in a curious 'Description' or map of its path, by Halley, formerly in my possession, now in that of the Royal Astronomical Society. It is accompanied by the following characteristic notice:—'The like Eclipse having not for many Ages been seen in the Southern Parts of Great Britain, I thought it not improper to give the Publick an Account thereof, that the suddain darkness, wherin the Starrs will be visible about the Sun, may give no surprize to the People, who would, if unadvertized, be apt to look upon it as Ominous, and to Interpret it as portending evill to our Sovereign Lord King George and his Government, which God preserve. Hereby they will see that there is nothing in it more than Natural, and no more than the necessary result of the Motions of the Sun and Moon; And how *well those* are understood will appear by this Eclipse.'

these total solar eclipses may be seen at once on Jupiter, and it will be interesting to mark their unequal velocities and distances from the satellites to which they belong.—Such is the regular mode of transit. But remarkable exceptions are not uncommon, owing to the variable brightness of the satellites, which sometimes cross the disc as dusky or even black specks; when deepest, almost like their shadows. This seems to have been first noticed by Cassini in 1665, but was more fully described by Maraldi in 1707, and referred to rotating or variable spots. After a long interval Schr. and Harding reobserved the phænomenon in 1796,[1] and perceived that the spots were sometimes only partial. More recently the great telescopes of La., Bond, D., and Se. have shown that these little moons[2] are liable to the formation of spots, just dark enough to be imperceptible in front of the fainter limb of Jupiter, but to start out rapidly in advancing upon the greater brightness of his centre, where they are generally dusky, irregular, and smaller than the shadow. I have sometimes seen them thus readily with my $5\frac{1}{2}$ f. telescope. South, who once found, with his large achr., two satellites of a light chocolate colour and their shadows on the disc at once (which must have been, what he calls it, 'a glorious view'), says he never saw one black: but at Cambridge, U.S., 1848, Jan. 28, when the shadows of I and III were both in transit, III itself 'was seen with the great

[1] In 1785 and 1786 Schr. repeatedly saw round black spots traversing Jupiter rapidly, like shadows of satellites, which M. says could not have been *dark transits*. It is quite unaccountable that H, and B. and M. in their *Beiträge* should have passed by these transits in silence.—De Gasparis is said to have seen (1864, July 22) a black point on the disc, which passed off it in 15^m.

[2] With the exception of II, which D. finds always bright: the brightest of all for its size.

refractor'[1] (Bond's) 'under very beautiful definition, as a black spot between the two shadows, and not to be distinguished from them except by the place it occupied. It was smaller than its shadow in the proportion of 3 to 5, not duskish simply, but quite black like the shadows.' Tebbutt saw several dark transits of III in 1873. That of IV, Mar. 26 in that year, remarkable for its absolute blackness, was seen by many observers in England; among them the late much-regretted Key, who noticed its very small appearance afterwards. Sometimes these spots have been so marked on III as actually to be visible to D., La., Se., Burton, and Sadler, when it was shining freely on a dark sky; the former has given the following figures, of which

the 1st represents what was seen both on and off the planet, 1860, Jan. 24, 31: and the 2nd the appearance during transit, 1849, Feb. 11; so as to imply in each instance an unchanged position of the satellite towards the Earth.[2] 1867, Aug. 1, when Jupiter was without visible satellites outside the disc, three being in transit at once, he again saw the double spot,[3] but on the opposite or SW. side. The 3rd fig. represents IV as he has sometimes observed it, with portions near the edge almost invisible from small reflective

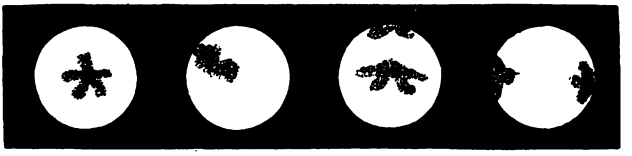
[1] 22⅔ f. focus, 14·95 in. aperture, by Merz, Fraunhofer's successor.

[2] G. says that on two occasions he has seen the light of this satellite reduced to a mere ring. Ingall, with a 5½ in. dialyte, saw it (1870, Feb. 17) like a double star in contact.

[3] *Barneby* also, who ascribes to it a ginger colour.

power. Burton, too, has seen it polygonal. Se., who found III reddish, and like the spotted face of Mars in a small glass, made designs during 1855, some of which are copied here,

Aug. 26. $19^h\ 20^m$. Aug. 26. $21^h\ 10^m$. Aug. 27. Sept. 9.



and from which he would infer a swift axial rotation; if so, these satellites must differ essentially from our Moon: that they do so to some extent is clear from the ephemeral nature of their obscurations, the same satellite often passing across Jupiter bright and dark at the interval of a single revolution in its orbit. An extract from my own observations, of a date long anterior to those of La. and Se., may be permitted as an encouragement to the possessors of ordinary instruments. '1835, Jan. 26, $10^h\ 30^m$, 250 [power of $5\frac{1}{2}$ f. achr.] The 4th [a little past inferior conjunction] was very pale, and rather ruddy; its disc not only smaller than that of the 1st or 2nd, but apparently imperfect as if spotted. Had the night been more favourable, this might have been a very interesting observation.'

From this change in the aspect of a satellite in dark transit—than which, as D. observes, no more delicate photometer could be applied to the different parts of the disc—we must infer a far greater difference of brightness between the centre and circumference of Jupiter than could have been suspected: a white disc would not be converted into a black one from mere contrast, unless the light of the background varied in a corresponding manner: and it is very strange that this variation is so little otherwise apparent to the eye. Browning,

however, has detected it, as I have since done, by means of a graduated darkening glass. On optical grounds we should hence deduce a very smooth surface for Jupiter, and one not covered with vapour, since this, as we see in the dense white clouds of our own sky, would not grow less bright towards the edge. One of the apparent anomalies of this system has been recently explained. The unexpected magnitude of the shadows, especially of IV, in transit, which had been noticed ever since Maraldi's time, has been shown independently by Proctor and Buffham to be due to enlargement from penumbra, into which, in consequence of its distance from the primary, nearly the whole shadow of IV is resolved, III being considerably affected by it, throwing a smaller and blacker shadow from a larger disc, and even I not exempt; these diffused borders, the visible extent of which will vary with the optical power employed, have actually been detected on several occasions by La., Buffham, Gorton, and others. An elliptical form which has been seen by Burton in the shadows is not fully explicable as the result of oblique projection, and seems rather to indicate penetration through an imperfectly transparent and not very shallow medium. Other appearances not easily accounted for are on record. Cassini once failed in finding the shadow of I when it should have been on the disc. Gorton saw it grey on one occasion. The shadow of II has been seen especially indistinct by Buffham, Birt, and Grover; Terby and Flammarion found it grey, 1874, Mar. 25, when that of III, very near it, was black. I saw it abnormally small with $9\frac{1}{3}$ in. mirror, at the same time. The Melbourne observers have seen the shadow of III flattened at its poles, in mid-transit, in a high N. Lat.; and Grover has recorded two somewhat similar observations of the same shadow. South, many years ago, published in one of the public journals a most interesting observation,

which I greatly regret that I cannot recover, but I am confident as to its tenour, which was, that in his great achr. he perceived each of two shadows of satellites on Jupiter to be attended by a faint duplicate by its side; traces of which could be just detected with a smaller telescope of (I believe) 5 f. But the most surprising is a phænomenon which requires, and possesses, the highest attestation. 1828, June 26, II, having fairly entered on Jupiter, was found 12 or 13^m afterwards *outside the limb*, where it remained visible for at least 4^m, and then suddenly vanished. The authority of such an observer as Smyth would alone have established this wonderful fact; but it was recorded by two other very competent witnesses, and (what is especially remarkable) at considerable distances, Maclear at 12 miles and Pearson at 35 miles from Smyth at Bedford. Explanation is here set at defiance; demonstrably neither in the atmosphere of the Earth nor Jupiter, where, and what could have been the cause? At present we can get no answer.[1]

SATURN.

FORTUNATELY for the student, a common telescope will exhibit some part of the wonders of this superb planet, unparalleled in our own system, invisible elsewhere; and they whose

[1] Gambart says that, at the immersion of I, 1823, Oct 19, 'le satellite a disparu et reparu plusieurs fois:' but in this case qu. as to the state of the air, or the eye? Observations by Se. and Main, in which the limb alternately approached and receded from a satellite for 4 or 5^m, were obviously due to unsteady air. Grover on one occasion saw the advance of II towards occultation entirely arrested for 1^m when 3 or 4 of its own diameters from the limb: definition splendid, and observation very certain.

expectations have not been unduly raised by designs made with the best telescopes will be delighted with the scene in their own. The minuter details require in general great optical perfection; but some of them may now and then be reached, though with a feeble grasp, by ordinary instruments, and our readers may have occasional access to more powerful means; it seems best, therefore, to be circumstantial. We shall describe the Globe, the Rings, and the Satellites, in succession.

The *Globe.* Though about 69,200 m.[1] in equatorial diameter, second only to Jupiter, and about 9 times larger than the Earth, this noble ball has so little density that it would float like oak on water, which is actually heavier, and therefore, if any were found there, would sink to its centre; while on the probable supposition that the density of the globe decreases outwards, its surface-material must be lighter still, and the conditions of existence there so unlike our own as to render conjecture hopeless. Seidel has shown that its reflective power is only $\frac{1}{5}$ of that of Venus, Mars, or Jupiter. Day and night, summer and winter, and possibly clouds and winds, the only steps in the analogy, leave an immense distance to be overpassed; and the tenfold nearer approach of modern astronomers has not bridged over the chasm which foiled the inquiries of Huygens, and kept him still in ignorance of the wonders beyond it.[2]

1. *Ellipticity.* There is no doubt of this compression, but much uncertainty as to its amount: the inclination of

[1] Measurements differ a little; this is the value given by Ne. as freed from irradiation.

[2] 'Ad longinqua Saturni regna propius nunc quam antehac quisquam adivi, et usque eo progressus sum, ut vasti adeo itineris pars una centesima tantummodo reliqua fuerit: quam si quo pacto superare potuissem, quot, qualiaque . . . . narranda haberem!'

the axis, corresponding with that of the ring, causes some difficulty; the intersecting outlines of the ring occasion more by deceiving the eye: and this has been the reason generally assigned why ♄ and others in 1805 considered that the ball was doubly flattened, at the equator as well as at the poles.[1] As, however, the great observer confirmed the appearance with several instruments, by comparison with Jupiter, and by actual measurement, the suspicion may recur that something is not altogether explained. The same peculiar outline presented itself to G. in 1844. Others, especially Bond II., have thought the two hemispheres not precisely alike in flattening. The best values of the compression vary between a little less than $\frac{1}{9}$ and a little less than $\frac{1}{12}$: at any rate it is very considerable. It is of course best seen during the disappearance of the ring.

2. *Excentricity.* Schwabe, though anticipated by Gallet, 1684, in perceiving that the globe is not accurately central in the ring, first drew general attention to the fact, observed by him in 1827 with a $3\frac{1}{2}$ f. achr. It has been doubted, but seems established by measures which give the dark opening a very little smaller on W. than E. side:[2] the Roman observers as well as Schwabe considered it very evident, but rapidly variable, in 1842 and 1843: and I have sometimes fancied it visible with the $5\frac{1}{2}$ f. achr. It has been thought theoretically essential to the stability of the ring.

3. *Belts* and *Spots.* The globe is diversified by darker and

[1] Proctor has shown very ingeniously that remarkable illusions are caused by the juxtaposition of lines of different character. This will be apparent from a diagram (taken from his in *Intellectual Observer*, x. 23) in which the two chords, though apparently curved, to most eyes at any rate, are really straight lines.

[2] Gallet reverses this position.

lighter bands, changeable, but usually parallel to the equator, though ♃ noticed occasional deviation. His 'quintuple belt' of alternate light and shade is now seldom to be seen: usually there is a strong central whitish band, the brightest part of the ball; on each side of it a broad brown or somewhat ruddy zone, with many streaks and markings, generally parallel, and, according to some authorities, reaching to the limb; to the principal of which the Washington achr. gives wavy edges: then a similar greenish or bluish grey region extending to the poles, which are capped by a darker patch of the same tint, with sometimes a pale central space. ♃ found the brightness of the polar regions variable. Browning describes the colours in 1868, with a 12¼ in. mirror, as light cinnamon and bright azure blue. Strange to say, B. and M. missed these belts, which Huygens discovered with his old refractor, and Grover has often seen with only 2 in. of aperture.—Spots or streaks are uncommon, and the instances easily enumerated: Cassini and Fatio, two bright streaks, 1683; ♃, 1780,[1] 1806; Schr. and Harding, 1796, 1797; Schwabe, 1847; Busch and Luther, a round bright spot near S. limb, 1848. Bond I., in 1848 and 1854, and De la Rue in 1856, figure some darker patches. La. and Jacob, 1852; Coolidge and Bond II., 1856; D. and La., 1858; Se., 1861. From the unequal strength of parts of his quintuple belt ♃ found the rotation $10^h\ 16^m\ 0{\cdot}44^s$. Schr., from various spots, $11^h\ 51^m$, $11^h\ 40^m\ 30^s$, and rather more than 12^h. But the best determination is that of Hall, who, 1876, Dec. 7, observed with the great Washington telescope a well-defined white spot of 2″ to 3″ which was seen at four other places, and continued for some

[1] The object figured by ♃ in *Phil. Trans.*, 1790, is called 'a strong, dark spot near the margin of the disk,' where even Bond's great *achr.* fails to trace the belts, and where, on Jupiter, the darkest *spots* are usually said to be imperceptible through his atmosphere.

weeks, extending itself ultimately on one side into a streak. This gave a period of $10^h\ 15^m$. An appearance which indicated an atmosphere to ♄—the hanging of the satellites on the limb previous to passing behind it—is as yet unconfirmed. The spectroscope of Huggins shows the existence of an atmosphere of similar quality to that of Jupiter; Janssen's indicates aqueous vapour in both. Vogel's shows more atmospheric bands on the ball than the ring. From the transit of Titan Chacornac found the reverse of Jupiter in Saturn as to reflective power, the edges being brighter than the centre.

The *System of Rings*, so far as has been ascertained, is unique; the only level surface, or rather collection of level surfaces, that we know. From the combination of its inclined position, its parallelism with itself, and the planet's revolution round the sun, it will alternately show each side to a distant spectator, and in two opposite points of the orbit come into an edgeways position and disappear. The whole revolution occupying nearly $29\frac{1}{2}$ years, all the phænomena of increasing and decreasing breadth will be gone through in something less than 15 years for each side of the ring: the widest opening, when the breadth almost exactly equals half the length, will occur in 1885–6, whence it will gradually contract to its edge-representation in 1892–3. To a spectator in the Sun, the ring would vanish but once as it changed sides to him, being invisible, or nearly so, from its thinness; on the Earth, being neither in the centre of Saturn's orbit, nor at rest, we may find it disappear in 4 positions—either edgeways to Sun and Earth—edgeways to Sun but not to Earth, when it will be too faint, each side having only a very little horizontal light—edgeways to Earth but not to Sun, when, though enlightened, it will be too narrow to be visible—or edgeways to neither, but having its dark side towards Earth: the motion of Saturn, however, carries it before very long through all these

points, and the previously hidden side comes definitely into view. We must now consider it as it will be in 1885–6, with the ring at its greatest width projecting beyond each pole of the globe: in this position it is brought out by a very small power—(I have seen it with about 20 on only 1⅛ in. aperture)—the dark sky being visible on each side through the 'ansæ' (or *handles*), as the semi-ovals of light are termed into which the ring is projected. Galileo's telescope, though it magnified upwards of 30 times, could not define it thus, and he imagined that he saw a large globe between two smaller ones: then followed a number of queer-shaped misrepresentations by various hands, till in 1659 Christian Huygens made for himself a refractor of 23 f. focus and 2⅓ in. aperture, which, bearing the power of 100, solved the mystery. His exulting father celebrated the discovery by a copy of verses, closed by a passage worthy of preservation, in which he thus anticipates for his son a fame as lasting as the firmament:

> Gloria sideribus quam convenit esse coævam,
> Et tantum cœlo commoriente mori.

The telescope now improved rapidly, and the cumbrous and troublesome refractor of those days was often exceedingly good for the kind of thing. 1665, Oct. 13, two brothers named Ball discovered, with a 38 f. telescope, the principal division in the ring,[1] which is now usually called after their name: it was rediscovered by Cassini in 1675, one of whose refractors, 20 f. long, with not quite 2½ in. aperture, bore a power of 90. A much lower power would not show it all round, as Cassini seems to have seen it, even in a modern achromatic. But we must proceed to details, adopting Otto Struve's designation of the three principal rings, by the letters, **A B, C.**

[1] Humboldt was not aware of this fact.

1. The *Outermost Ring* (**A**), about 154,500 miles outside measure, was perceived by Cassini, as early as 1675, to be considerably fainter than the outer part of its neighbour; a small telescope will readily show the difference. There seems reason to believe that its structure is either always, or temporarily, multiple. Short in the last, Kater in this century saw, on rare occasions, several concentric fine lines upon its surface. The strongest of these, named after Encke, who first drew attention to it in 1837, is perceived from time to time rather outside the middle of the ring. Jacob saw it constantly at Madras, and P. Smyth found it very distinct in the pure sky of the Peak of Teneriffe; La. and Se. find only a dusky mark like a pencil line, D. and De la Rue consider it a black division.[1] Immediately within it, the latter observer represents a brighter streak in the exquisite drawings taken in 1852 and 1856 with his reflector of 13 in. aperture, now at the observatory of Oxford. Se. has perceived another most minute line interior to the first. With has seen several hair-lines upon **A** at once with one of his own specula. D. and Coolidge (Bond's assistant) have remarked a greater brightness at the inner edge, La. (at Malta) at both edges of this ring. Common telescopes of course break down here, yet I have once or twice suspected a streaky aspect with the $5\frac{1}{2}$ f. achr.: but it is very strange that these markings have escaped many of the best telescopes, especially

[1] In 1851 and 1852 D. saw this line when Bond, Struve, and La., with three of the finest telescopes in existence, missed it. It was subsequently seen dusky in Bond's. 1858, Apr. 17, during an unusual display of Saturn, La. could only detect a very slight shade. Burton has recently seen it even across the ball, in the present imperfectly opened condition of the ring (Aug. 1880), which Trouvelot failed to do with the great Washington achr. in a much more favourable position. I caught the *line*, 1880, Oct. 14, with $9\frac{1}{3}$ in. refl.

directed to Saturn,—those of the two Herschels,[1] Schr., Struve at Dorpat, and Mitchel at Cincinnati. Possibly they may be subject to obscuration or change. Trouvelot has seen with the $26\frac{1}{2}$ in. achr. at Washington minute notches in the inner edge at each apparent extremity.

2. The *Ring* **B** begins from its very sharp outer border with a luminous region, sometimes the brightest part of the whole system, though according to Schr. and Schwabe variable—a circumstance which I have also noticed, finding it more conspicuous in 1853 and 1855 than in 1856 and 1857: the inner edge is very obscure; Schumacher and D. have seen it much better defined on one side of the ball. From one rim to the other there is an increasing shade, formerly considered regular, but found by La., D., and Se. to consist of 4 or 5 concentric and deepening bands, compared by La. to the steps of an amphitheatre; each may be a separate ring, since fine black lines were at times traced here by Encke, De-Vico, and Coolidge,[2] and Bond's telescope showed markings like narrow waves of light and darkness. De la Rue and D., in another year, have seen a lighter central band. The innermost edge is sometimes brightened up—in other seasons it fades. I saw it in 1853 without any previous knowledge, on one ansa, with only $3\frac{7}{10}$ in. aperture: in 1856 it was less visible, and went beyond my range in 1857.

3. The *Ring* **C**, the crape or gauze veil, is one of the greatest marvels of our day. How it could have escaped so

[1] In an admirably perfect view of Saturn by H., 1830, Apr. 4, with his 20 f. reflector, $18\frac{3}{4}$ in. aperture, no subdivision could be traced 'with all possible attention and with all powers and apertures.'

[2] H saw such a line in June 1780, for a few days on one ansa *only*. De-Vico's observations are not always satisfactory.

long, while far minuter details were commonly seen, is a mystery. Schr., in 1796, with his great reflector, 26 English f. focus, 19 in. aperture, particularly examined the space on each side of the ball, and found it uniformly dark; if anything, darker than the sky.[1] Our great observers the two Herschels never perceived it. Struve measured Saturn repeatedly in 1826 with the superb Dorpat achromatic, 14 f. focus, $9\frac{6}{10}$ in. aperture, but missed it, though he saw the inner edge of **B** very feebly defined. In 1828 a fine Cauchoix achromatic of $6\frac{1}{3}$ in. aperture having been placed in the Roman observatory, it was seen, as an old assistant informed Se., both in the ansæ and across the ball, yet, strange to say, and little to the credit of Roman science at that time, *no notice whatever was taken of it*. Ten years later, in 1838, the matter fell into worthier hands;—Galle of Berlin, with a glass the counterpart of that at Dorpat, detected and measured it very accurately, and published his observations; yet they somehow went on the shelf till, in Nov. 1850, Bond in America, and our own D., had each the honour of an independent and original discovery; and now everybody may find it with a sufficient aperture: it has been well seen with $3\frac{3}{8}$ in. achr. by Ross; I saw faint traces of it with my $3\frac{7}{10}$ in.; anything larger, if good, is sure to bring it out.—Where was it for so many years? Probably some change may have rendered the part projected on the sky more luminous; but it is not a new formation, for where it crosses the ball it has been seen ever since Campani's time, 1664: and it was even repeatedly noticed that its outline did not suit the perspective of a belt on Saturn, as it was supposed to be, or that of a shadow thrown by the ring: on this bright background it is so easy that Grover has seen it with a 2 in. aperture. It

[1] Bond's telescope shows the same appearance between **C** and the ball. It has been seen also by Whitley, 1870.

reaches half-way or rather more from the edge of **B** to Saturn: at its first discovery D., and Otto Struve at Poulkova (the Czar's observatory), with the superlative achr. by Merz, 22⅓ f. focus, $14\frac{9}{10}$ in. aperture, considered it to be divided in two by a dark line; but this has not been seen since; nor is it certain whether there is a division between it and **B**, or whether it is fainter towards its inner edge. Its generally slaty hue has been at times found different on the two sides of the planet, reddish and bluish; and a repeated interchange of these tints, noticed by La. and D., might indicate rotation; its width and brightness in the two ansæ have been occasionally seen different; its narrowness in front of the ball has induced an idea that it is not in the same plane with the rings **A** and **B**; and, in 1861–2, some nebulous light attending the edge-view of the ring, on each side of the globe, as observed by Struve II. and Wray, might perhaps be the result of its perceptible thickness: 1863, Mar. 26, Carpenter at Greenwich found it almost as bright as **B**, for part of which it might easily have been mistaken. D., Jacob, and La. have concurred as to the very curious fact of its partial transparency, permitting the limbs of Saturn to be traced through it.[1] Trouvelot, with the 26½ in. achr., and Common, with his noble 36½ in. mirror, have thought it speckled, as though consisting of separate particles. Possibly a similar material may fill Ball's division, as this has been sometimes seen not quite black, and Jacob has even followed the shadow of Saturn across it. Many slight variations lead to the inquiry whether this grand system is really permanent in its detail. Se. thought the

[1] Perceived by Whitley (1870) with a 6½ in. silvered mirror. Bond saw it transparent throughout; but Trouvelot, in 1876, distinctly found, with the Washington achr., the transparency gradually *diminish* from the inner edge, till half-way across it disappeared.

bright rings might be clouds in an imperfectly transparent atmosphere,[1] which is visible in the ring **C** and Ball's division; and the American mathematician Pierce considers it demonstrable that the ring is not solid, but may be a stream or streams of a fluid rather denser than water, adding, in the spirit of a true philosopher, 'Man's speculations should be subdued from all rashness and extravagance in the immediate presence of the Creator.' An idea suggested by Cassini II., that it may consist of a multitude of satellites, has been earnestly advocated by Proctor, but would not be applicable to **C**, excepting on Burton's ingenious suggestion, that the separate particles, though brighter than the sky, may be less luminous than the ball; corresponding with the 'dark transits' of the satellites of Jupiter. The passage of the rings over a considerable star might give us some further information; but such events are very infrequent. Whiston states that Dr. Samuel Clarke and his father, about 1707 or 1708, saw a star with a 17 f. refractor between the ring and Saturn, but nothing of the kind has been since recorded. D. alone has seen, but under unfavourable circumstances, a star between 8 and 9 m^{g}. pass behind the outer edge of **A**. In such a case, all attention should be given to the visibility of the star through at least Ball's division, and the dark ring. The shadow of the planet upon the rings is readily seen, except near the opposition, cutting off one of the four arms of the ansæ from apparent contact with the ball: Grover has perceived it with a 2 in. aperture. The outline of this shadow has often been found curved the wrong way for its perspective, or deviating on ring **A** from its line

[1] The ring was suspected to have an atmosphere by ♅ from the apparent threading of the minutest satellites upon it when reduced to extreme thinness.

on **B**;[1] something of this kind has been noticed ever since Cassini's time, and I have seen traces of it with the $5\frac{1}{2}$ f. achr.; the shadow of the ring on the ball has also been observed notched by Schr., La., De la Rue, and Jacob. Hence an uneven surface would be inferred, and Se. finds that a reversed curvature would result from a slight convexity in the ring; but in each case we are at once confronted by its total or nearly total disappearance when viewed edgeways, seeming to demonstrate absolute flatness: it cannot however be quite symmetrical, for not only do the opened ansæ sometimes show an unequal breadth of some or all of their lines and markings E. and W., but about the time of their vanishing or reappearance they have been repeatedly seen, ever since 1671, variable and unlike in length and thickness and continuity. When the light of the ring has been reduced to a thread, knots of greater brightness have often been noticed upon it. From the supposed motion of some of these in 1789, Herschel deduced a rotation in $10^h\ 32^m\ 15^s$, which an examination of the original observations will show to be without foundation. Schr. and Harding (1802, 1803), Schwabe (1833, 1848), Schm. and Bond (1848), and Se. (1862), found them all immovable.[2] Schr. supposed that they were

[1] Bond II. and Coolidge, in 1856–7, saw it strangely flattened, with a deep notch, like the eaves of a roof, and it was unequal in depth of shade: it was also visible on each side of the ball at once, and exhibited corners in crossing Ball's division; several of these strange anomalies have been confirmed by D., La., Se., Jacob, and Trouvelot. We must bear in mind the source of illusion mentioned in p. 173, note 1: some of the phænomena, however, cannot be thus explained. Grover has several times seen very distinctly a penumbra to the shadow of the ball, as in the frontispiece to *Kitchiner on the Telescope*.

[2] De-Vico saw on several consecutive nights in 1840, and once *in 1842*, a fixed bright point attached to the open ansa. This, with

mountains; Olbers, more probably, that they were the perspective aspect of such parts of the ring as show the greatest breadth of light. Bond finds this insufficient, as they are not lost when the dark side is turned to us, and he thinks that they may be explained by the reflection of light from the interior edges, seen through the openings of the rings. Yet many observations indicate too much irregularity to be so readily accounted for.—When it stands edgeways, or turns its dark side to us slightly, the whole system totally vanishes in ordinary instruments. ♅ seems to have kept hold of it, probably in parts, and Bond did not quite lose it in 1848, though it was seldom continuous: in 1862 Se. kept the thread in sight, and the Greenwich equatorial showed an interrupted line. The thinness of this enormous plane is literally matter of astonishment; H. estimated it at 250 miles; Bond allowed it but 0″·01, or 40 miles—about $\frac{1}{4000}$ of its diameter! In 1848 and 1862 D. saw traces of the dark side when turned to us, of a deep coppery tinge;—Huggins, 1862, dark blue. The next disappearance in 1892–3 will be looked for with especial interest; and the possessors of ordinary instruments need not be disheartened; the slender line of light is a beautiful spectacle; and my fluid achromatic of 4 in. aperture, but of which much of the light went the wrong way, lost it in 1833 only one day sooner than Smyth's achr. of nearly 6 in., and but four days sooner than H.'s 18 in. reflector.[1] Saturn at such times shows usually a dark and very visible streak across his face, which D., Schm., and Wray have divided lengthways,—the unenlightened side of the ring, and its shadow: the latter

the instrument and eye of his successor Se., would alone have negatived a rotation.

[1] Lardner says, H. did *not* lose it: not a solitary instance of inaccuracy.

has sometimes been invisible, when it ought to have been seen; D. thinks from an atmosphere. Schwabe and other observers have thought the belts not exactly parallel to the ring in this position.

The *Satellites.* The very confused way in which the members of this numerous retinue were formerly designated, by numbers counted in two different directions, has been superseded by H.'s ingenious nomenclature, in which the names reckoned towards Saturn are easily remembered in a Latin pentameter and a half—

> Iapetus, Titan, Rhea, Dione, Tethys,
> Enceladus, Mimas.

This arrangement has been since disturbed by the simultaneous discovery in 1848 by La. and Bond of an 8th, Hyperion, extremely faint, between Iapetus and Titan.—The lesser of them belong only to the highest instruments: the innermost has never been seen certainly with anything smaller than a $6\frac{1}{3}$ in. object-glass, and with that only in the purer skies of Paris, Rome, and Madras. Kitchiner and Wray have seen it with a 7 in. in England. The next, though easier, is still very minute; Ward, however, has detected it with a $4\frac{3}{10}$ in. achr., Franks with 5 in. do.; Perry with a $6\frac{6}{10}$ in., I with a $9\frac{1}{3}$ in. mirror. But Titan, the leader, is very conspicuous, being equal to an 8·5 m^g. star, so that it was discovered by Huygens in 1655, in which year it was also seen, though not suspected to be a satellite, in England, by Sir Paul Neil and Sir Christopher Wren. In fact, this little point of light, which may be seen with 1 in. aperture, has in large telescopes a disc of about 0″·75, and probably ranks in size between Mercury and Mars. Its shadow was *watched* by ♅ in 1789 in transit across the disc of Saturn;

G. saw it in 1833; in 1862 it was observed by D.[1] and several others, including myself; it was seen twice at Dun Echt in 1877, and once by Hunt in 1878. Gledhill, Ward, and Bazley have also witnessed this curious but not difficult phænomenon, which Banks saw with $2\frac{7}{8}$ in. as easily as the shadow of I on Jupiter.—Iapetus is not small, though probably, from a spotted surface and rotation like our Moon, not always equally visible, being much brightest at his W. elongation.[2]—Rhea, Dione, and Tethys are more minute.[3] D. considers Tethys superior to Dione. Kitchiner states, from a friend, that, by hiding the planet, they have been seen with $2\frac{7}{10}$ in. aperture; Capron has seen them with $3\frac{1}{4}$ in.; Banks has seen four with $2\frac{7}{8}$ in.; Grover two, with only 2 in.; $3\frac{3}{4}$ or 4 in. may be expected to show all five. The three smaller are easier when further from the planet, but they only depart from it respectively 9·6, 6·9, and 5·4 of its radii. ♄ could follow all then known up to the disc. Schr. found them variable, like Iapetus, but brightest towards E. instead of W. ♄ has seen 7 brighter than 6. The inclination of their orbits, nearly similar to that of the ring, by spreading them over the sky, increases the difficulty of distinguishing them from small stars in one night's obser-

[1] This observer also witnessed the immersion of Titan in the planet's shadow.

[2] The change, according to ♄, is equivalent to that from 2 to 5 m^s. Cassini, however, had found it uncertain. So Banks, 1866.—A confusion exists in some astronomical works with respect to the relative size and variable light of this satellite and Titan.

[3] That Cassini with his inferior means should have not only discovered them, but traced their periods, reflects great credit upon his ability; it is gratifying to be able to subjoin the striking encomium of his Éloge:—'Les cieux qui racontent la gloire de leur Créateur n'en avoient jamais plus parlé à personne qu'à lui, et n'avoient jamais mieux persuadé.'

vation: and hence, probably, many mistakes have been made. To a spectator placed on Mimas, revolving in less than 23^h at a distance of only 32,000 miles from the edge of **A**, the whole system of rings and the included globe would float before the eye in such a spectacle of grandeur and beauty as the imagination is wholly unequal to conceive.

URANUS AND NEPTUNE.

THESE planets may be reached, but to no great purpose, with ordinary means. URANUS, being visible in clear weather to the naked eye, will be easily caught up in the finder by the help of the almanac, and will be large and planetary-looking in the telescope; its disc indeed subtends less than 4″, but I never found the light of $3\frac{7}{10}$ in. sufficient to define it perfectly; $5\frac{1}{2}$ in. dealt far better with it: with Lawson's 7 in. object-glass, bequeathed to the Greenwich Naval School, I have seen it beautifully, as a little Moon: no one has made out much more: M. has seen it elliptical, and measured the flattening: La. with his 2 f. speculum, and in the sky of Malta, once thought it possible there might be a spot: Buffham (1870–1) considered that he succeeded in detecting, with a 9 in. With mirror, white spots, portions probably of a discontinuous belt, from which a rotation from N. to S. might be imagined. The $26\frac{1}{2}$ in. Washington achr. finds nothing, but the Bothkamp $11\frac{1}{2}$ in. achr. has shown a lighter speck on the N. limb of the sharp sea-green disc. The two rings suspected by ♅ have long been abandoned, and La. has reduced the satellites to 4, which even the $5\frac{9}{10}$ in. object-glass of Smyth was incapable of reaching. Ward, however, has glimpsed *the two* outer ones, Oberon and Titania, with a $4\frac{3}{10}$ in. Wray

achr., as Huggins has with 8 in. achr., and Sadler with a $6\frac{1}{2}$ in. mirror. My less acute eye has just caught one with $9\frac{1}{3}$ in. speculum. Marth has found their visibility not affected by moonlight. Huggins and Se. differ as to the details of its spectrum, but it is unquestionably a very extraordinary one, crossed by 6 broad absorption-bands, one corresponding with hydrogen, the rest of unknown character.

NEPTUNE may be found in the same way, but will hardly repay the search: I have several times seen him with my $5\frac{1}{2}$ in. achr., but dull and ill-defined; neither indeed would the great instruments of Se. or Vogel give him a sharp contour. His satellite, supposed by some to be the largest of its class, and held steadily by D. with 8 in. achr., no common telescope of course would touch; though Ward has glimpsed it with a $4\frac{3}{10}$ in. achr. But who can say how grand a spectacle this inconspicuous globe might present on a nearer approach? or what mysteries might be developed in a spectrum much resembling, according to Se., that of Uranus? or that he is the most distant planet that obeys our central Sun? or what unexplored wonders may lie in still remoter space? 'Quis unquam exhaustas dixerit cœli copias?'[1] The advance of optical power may be expected either to open up fresh marvels, or prove to us that, as far as the dominion of our own Sun is concerned, we have reached the boundary of our knowledge.

[1] Bianchini.

COMETS.

Thou wondrous orb, that o'er the northern sky
Hold'st thy unwonted course with awful blaze!
Unlike those heavenly lamps, whose steady light
Has cheered the sons of earth from age to age,
Thou, stranger, bursting from the realms of space
In radiant glory, through the silent night,
Thy tresses streaming like the golden hair
Of Atalanta, or that beauteous maid
Pursued by Phœbus, upward shalt invite
Many a dull brow unus'd on heav'n to turn,
And many a bosom rend with deep alarm.

Where is thy track throughout the vast expanse?
Still onward hast thou urged thy bold career,
From that first hour when the Creator's hand
Impell'd thy fire along the fields of light,
Nor ever yet arriv'd within the verge
Of mortal ken, nor drank the distant beams
Of our inferior sun, unask'd by thee
To guide thee harmless on thy rapid way.

REV. JOHN WEBB (1811).

WHEN Kepler stated his belief, not merely that comets inhabited the æther as fishes the ocean, but that the ocean was not fuller of fishes than the æther of comets,[1] his contemporaries probably amused themselves with his luxuriant fancy. Yet Kepler was not so far wrong as regards number; for it is now believed that upwards of 4,000 have approached the Sun within the orbit of Mars during the Christian æra. A twelvemonth seldom passes by, in these days of telescopic activity, without the announcement of several; 1858 produced 8, and sometimes 3 and even 4 (as in Feb. 1845) have been

[1] 'Nec minus ætherem cometis refertum esse puto, quam oceanum piscibus. Quod autem rari apparent nobis, ingens ætheris vastitas *in causâ est.*'

in sight at once: but of late conspicuous ones have been far from common. The generality are faint, and so much alike, at least in ordinary telescopes, that they offer little attraction beyond the curiosity of watching their progress: this, where there are stars for sky-marks, may be sometimes traced from hour to hour, and, in connection with the enormous distances traversed, gives a grand idea of the majestic movements of the universe. But larger comets are often equally imposing to the naked eye and marvellous in the telescope; of which we had a splendid instance in 'the Donati,' or, in astronomical language, Comet V, 1858—that is, the 5th in order of that year—and again in the less beautiful, but in some respects more impressive, Comet II, 1861: while Comets III, 1860, and II, 1862, were not less worthy of notice for peculiarity of structure; and 'the Coggia' of 1874, by the brilliancy of its star-like nucleus, and the complexity of its intersecting envelopes, distinguished itself above its congeners through many previous and successive years. It would lead us into too wide a field, as well as one already cultivated by abler hands,[1] were we to describe separately the more remarkable of these bodies; it will be better, therefore, to sketch a general outline, which may serve to direct our expectations in future. First, however, we will give directions for finding them, when invisible to the naked eye.

If a comet is too faint to be readily perceived by moving about, over the proper quarter of the sky, a hand telescope with a large field (an opera glass may answer well), we must

[1] See Hind's excellent treatise, *The Comets* (1852), and Bond's *Account of Donati's Comet*, Cambridge, U.S., 1858; but especially his admirable Memoir in *Annals of Observatory of Harvard College*, iii. Pingré consulted 616 authors for his Cométographie (1783); and there were, in 1841, 382 works on the subject in the Poulkova library.

take our larger instrument and 'sweep' for it thus: ascertain its probable position—not, of course, at the date of discovery, but at the present time, if the announcement gives a clue to it; put in the lowest eye-piece, point the telescope some distance below, and on one side of, the supposed place of the comet, and gently move it horizontally right or left, as the case may be, till it points about as much on the other side. When your first 'sweep' has been thus completed, raise the telescope vertically half the breadth of the field, or not much more (as a faint object too near the top or bottom might be missed), and sweep back again the same distance the reverse way, ending pretty nearly where you began, but of course half a field higher; raise again another half-field, and sweep on, till either the comet sails across the field, or you are evidently pointing much too high for it: in which case you may conclude that it is too faint for you, or has gone away so far as to make further search useless. The movement may, of course, as well be begun above as below the supposed place of the comet. This process of sweeping is equally available for finding Mercury or Venus in the daytime, or minute stars or nebulæ at night; the chief difficulty lies in so proportioning the vertical movement that the object shall not escape between the sweeps; this is easy with rackwork, as the breadth of the field, and the suitable number of turns of the handle, may be previously ascertained by trial on a terrestrial object; with a plain stand there is little trouble in it where stars occur frequently to guide the displacement of the field; but by day, or in twilight, or in barren tracts of sky, sweeping without rackwork is less certain, and may require to be repeated.

The light of most comets is too faint for high powers, and demands a contrast with the dark sky which small fields do *not admit*: to get the whole extent of head or tail the lowest

power should be chosen, and for the tail the naked eye will be more effective than any glass, except the appropriate instrument called a Comet-finder: high powers may be used for the details of the nucleus, but the contraction of the field and the want of contrast must always be allowed for. Small comets are frequently nothing but luminous mists without trains, sometimes without central condensation;—as we ascend in the scale, nuclei, trains, envelopes, and various anomalous appearances succeed, depending probably upon diversities in the constitution of the comets themselves, as well as on their degree of approach to the Sun;—even Venus was thought to have influenced the aspect of 'the Donati,' as it passed near her. In common language, a comet consists of *head* and *tail*; but we have to make a telescopic analysis, and shall begin with

1. The *Nucleus*: the most luminous part, occupying in a general sense the centre of the head. It is sometimes absent in telescopic comets, which are mere fogs, permitting the minutest stars, even such as would be effaced by the slightest terrestrial mist, to be seen through the very centre;—thus H. saw a group of 16 and 17 m^{g}. stars through the heart of the comet of Biela in 1832: from this diffused state they present every stage of condensation, including sometimes a sparkling or granulated appearance, up to the aspect of a star, which has occasionally, as in 1744, equalled Venus in brightness, and been visible to the naked eye in broad noonday, or, as in 1843, blazed out yet more splendidly like a bright white cloud, close to the glowing meridian Sun.[1]

[1] Other comets visible by day (omitting some questionable ones):—A.C. 43, the star of 'the mightiest Julius,' which appeared during the games held soon after his assassination, and gave rise to the star on the forehead in his coins and statues;—1106, 1402, 1577 (Tycho's great comet), 1618. That of Feb. 1847 was seen by

High powers, however, usually dissolve any apparent solidity, and different instruments may give very different sizes to what looks like a planetary disc, throwing much doubt upon its reality: sometimes a very minute point (as ♅ found in 1807 and 1811) holds out against any magnifying; and such was the case again in 1862, when it remained a point at Poulkova, under a power of 1,458; and this—like broader nuclei—is not always central in the head. In some comets (1618, 1652, 1661, 1707, Winnecke's 1869) the nucleus seems to have been composed of separate masses,—a marvellous structure;[1] would that we could often study it with modern advantages! Had 'the Donati's' nucleus passed about 20′ further N., it would have gone right over Arcturus—and we might have obtained some negative information at any rate as to its composition. Miss Mitchell alone seems to have caught what seemed the central transit of a comet (1847) over a 5 m^g. star, which shone through it unchanged. Still, were the nucleus a mere point, it might have been only a very close appulse; and some minor examples are less conclusive.[2] Hirst, however, at Sydney, witnessed what appeared a good instance, when Encke's comet passed directly over one of two neighbouring 10 m^g. stars, affording an

Hind, and that of Aug. 1853 by Hartnup and Schmidt very near the Sun; but in each case with the telescope, in which they showed planetary discs. Donati's comet was not visible, except with very powerful instruments, by day.

[1] There is a strange story of visible internal movement among these subordinate nuclei in 1618—as if of coals stirred in a fire. This seems like a bad telescope or an alarmed observer—yet where all is mystery, neither credulity nor its opposite is the part of wisdom.

[2] Donati saw a 7 m^g. star enlarged so as to show a sensible disc, when the nucleus of Comet III, 1860, passed very near it. Stars *are said* to have started, or become tremulous, during occultation by

excellent criterion of absolutely unchanged light. Were a defined phasis to show itself, a certain amount of density might be inferred; but if we except 'the Donati' as seen by D. in daylight, Oct. 8, this has never been satisfactorily the case, as the retroverted form often assumed by luminous sectors throws a doubt upon the observations. The darkness close behind the nucleus in 1858, if not real shadow, seemed at least to prove that the nucleus was not permeable to the solar energy, in whatever way exerted, and that it had no rotation upon an axis. The arrival of the next great comet will be a season of absorbing interest, as we shall be much better prepared for its reception. The spectrum analysis, first of Donati, subsequently of Huggins, Se., and several others, has shown not only the native light of the small comets which have appeared since its employment, but what had been little anticipated, their gaseous character, and the close resemblance of the majority of their spectra to those of some of the compounds of carbon. There can now be little doubt that such is the constitution of larger specimens also: but probably with much variety in composition, as the acknowledged difference in colour makes sufficiently evident; and the nature of the nucleus is still incomprehensible.

2. The *Coma* is the sphere of mist around the nucleus, forming in popular language the *head*: this is sometimes of considerable extent—2° 40′, or 5 times the Moon's diameter, in 1770, when the nearest recorded approach of a comet to the Earth took place, of 1½ million of miles. The coma fades away into the surrounding sky, with an outline, including that of the commencing tail, usually considered parabolic; Bond, however, found in 1858 that its section approached

comets. Birmingham observed the comet of Encke illuminated by a star over which it passed, 1868, Aug. 23; and Klein in 1861 remarked an exceptional twinkling in 5 m^{s}. stars involved in the tail.

much more nearly to a catenary curve. Its denser part, if distinguishable by any set-off or outline, is called

3. The *Envelope*. This is an interior and brighter layer of mist, suspended as an atmosphere around the nucleus, at least where exposed to the sun: in Donati's comet some observers (amongst them myself) carried it a good way round the back of the nucleus; but usually it turns straight off on each side to form the commencement of the tail: within it is sometimes a darker narrow band, separating it from another interior and brighter envelope.[1] In 1858 no fewer than four such dark spaces at once were sometimes shown by the great achromatic at Cambridge, U.S., indicating the consecutive rising of five shining waves, which had spread themselves in succession outwards from the nucleus; the latter seeming to diminish in size and brightness after each of these emissions of luminosity. M. at Dorpat noticed an actual increase of one of these envelopes from 18″ to 27″ in 2^h. Occasionally, as in 1861 and the 'Coggia,' the nucleus appears not to occupy the axis of some of these veils, which consequently seem to cross one another in front of it. In 1811 the whole coma and envelope were raised in one parabolic mass from the nucleus, which was surrounded by clear dark sky on every side: when the extreme diameter of the luminous cloud amounted, according to Schr., to 947,000 miles, considerably exceeding the bulk of the Sun, and almost doubling the Moon's orbit. As this comet receded, the dark space became indistinct, and the envelope sank finally down upon the nucleus. Envelopes sometimes contain dark spots and streaks (1858), and more frequently brushes or fans of light, where the shining matter seems to stream out from circum-

[1] Huggins has made the important remark that these non-luminous spaces may correspond to a condition of the vapour too *cool* to emit light, and yet not condensed so as to reflect it.

scribed portions of the nucleus; these are rapidly variable, and in Halley's comet at its return in 1835 showed such a libration from side to side, traceable from hour to hour, that Bessel inferred some powerful polar force unconnected with gravity. Such a swinging was less distinctly recognised in 1858. In Comet II, 1862, in which these sectors or aigrettes were very striking, Se. and Chacornac perceived, otherwise than Schm. no motion of this kind, but thought that the jets proceeded alternately from different parts of the nucleus. The last observer found the light of the nucleus variable inversely as the breadth of the sector in 2·7 d., and that the luminous matter ascended towards the Sun with a velocity of nearly 2,200 miles in a second. In Coggia's comet With saw an evident oscillation one evening. The envelope and coma together form the origin of

4. The *Tail.* This, when not greatly foreshortened, appears as a long cylinder or more usually cone, widening in general as it advances, and showing a hollow structure by an interior darkness. There seems, however, a doubt of the adequateness of the explanation; since the perspective of 1858 required a very different proportion either of the *breadth* or the *intensity* of the dark space: some other cause may possibly be combined with vacancy to produce the effect. This interval in the Donati was very dark close behind the nucleus; Schwabe found it darker than the twilight sky, and D. and Hartnup considered it a *real shadow*: in 1811, however, such a vacancy surrounded the nucleus on every side. The division into two streams effected by it was seen with the naked eye in the great comet of 1577, which astonished Tycho at his fishpond before sunset, and it has been frequently noticed since the discovery of the telescope; in 1843 it was absent; and a brighter ray filled the middle when Halley's comet in 1835 was withdrawing from the

Sun. The preceding stream according to the comet's motion is usually brighter and sharper defined, as well as curved backwards. Kepler noticed this in 1618, and compared it in his own graphic way to the appearance of a heap of corn swept over by the wind in the threshing-floor: and no one will forget it who saw the form of the Donati.[1] It has been usually referred to motion through a resisting medium: but Pape, from an elaborate investigation, finds that the curvature may be explained by the combination of the comet's motion with a repellent power in the Sun. The axis of the tail was calculated by him to differ 6° 18′ from exact opposition to the Sun, being left a little behind—a deviation of which there have been previous examples.[2] The length of the tail is sometimes enormous. According to Boguslawski, that of the wonderful comet which in 1843 nearly grazed the surface of the Sun, and, as Se. expresses it, issued from it like a dart of light, was cast away to the almost incredible extent of 581 millions of miles[3]—more than 6 times the distance of the Earth from the Sun, and crossing the orbit of Jupiter; and this astounding stream, the longest object, as far as our senses can reach, in all space, must have been shot out with an equally inconceivable velocity after passing the perihelion; for, but a short time before, the head was on the other side of the Sun, half round which it had

[1] Towards the close of its appearance, the American observers noticed a reversal of the brightness and definition of the sides of this comet's tail. They also found, contrary to the common opinion, that the plane of its curvature was not identical with that of its motion: how this can be reconciled with Pape's theory does not appear.

[2] According to Schi., the tail of Comet III, 1862, was forced out in a direction very different from that of the *radius vector*. The very long train in 1769 was stated to have shown a double curvature towards its end.

[3] According to the then received solar parallax.

been whirled in $1\frac{1}{2}^h$ or 2^h, and under such circumstances the whole direction of the same tail could not be supposed to have been reversed. Even should the length be considered to be overstated, we certainly have before us here one of the greatest marvels in the universe. Minor trains are occasionally seen; in some cases (1769, 1811) the prolongations of an outer envelope; in others apparently separate branches (1806, 1843); according to Chéseaux, six of them, each hollow, formed a glorious fan in 1744. A straight, long, narrow, and very faint ray of this kind, directly opposite to the Sun, was seen by several observers steadily preceding the great curved tail in 1858. The grand visitor of 1861 had a straight and a curved tail, the latter of which probably swept over our globe, or, according to Liais, buried it to a depth of 110,000 leagues. From certain periodical returns of lateral streams, Dunlop in 1825 inferred a rotation of the tail in $20\frac{1}{2}^h$, and similar appearances were noticed in 1769, 1811, and 1862; but the explanation is perhaps precarious, from the immense velocity required. An additional stream has sometimes, though rarely, been directed *towards* the Sun; this extraordinary phænomenon, called an *anomalous tail*, was noticed in 1824, when it was longer and brighter, though narrower and more tapering, than the usual one; subsequently it was found recorded that the grand comet of 1680—Newton's comet—had left a similar glowing wake upon the æther; and it has since been noticed in 1845, 1848 (Encke's, —perhaps again in 1871), 1850, and 1851.[1] The principal tail in 1858 was seen by the Americans crossed obliquely by a number of brighter bands like auroral streamers, diverging from a point between the nucleus and the Sun.

A few other details should be noticed. *Coruscations* or

[1] One of the three short rays, besides the tail, seen in 1577, may possibly have been of this character.

flashings have been often remarked in the tail: that of 1556 was said to waver like the flame of a torch in the wind; and numerous other instances might be given, before and since the use of telescopes. The accurate Hooke took many precautions before he satisfied himself of their reality in 1680 and 1682, and Schr. stoutly maintained their existence in 1807, referring them to electricity or some analogous cause; others negative them as too rapid for the progressive motion of the light by which we should see them—an objection, however, applying only to foreshortened tails—and treat them as illusions depending on our own atmosphere, or the uncertainty of weary sight. Polarization experiments concur with spectrum-analysis in discrediting their reality, by showing that the denser portion of the tails, as well as comæ, shines in part by reflected light; owing probably, as Huggins suggests, to the cooling of the incandescent material of the nucleus. It would have added greatly to the interest of the present pages, could they have embodied more satisfactory results of spectroscopic research. But we are waiting for favourable opportunities. There seems no doubt, as we have said, that the materials of the smaller comets are of a gaseous nature, generally, though not invariably, affording spectra analogous to those of compounds of carbon. This is sufficiently marvellous; but the still more curious enquiry into the nature of the nuclei in the grander specimens remains unsolved. The sole instance, that of the 'Coggia,' to which it has as yet been applicable, has only increased the mystery. The spectrum of this resplendent stellar point was so far continuous as to prove unborrowed light; so far interrupted, especially at the red end, as to indicate emission or absorption by materials wholly unknown. Possibly some more intelligible disclosures may be in store for us. But even should we be permitted to lift partially in *some* special instance the veil, we are still confronted by those

differences of colour which appear to indicate a difference of constitution. 'Omnia incerta ratione, et in naturæ majestate abdita.'[1]

As regards *colour*, a wide margin must no doubt be left for the superstition of the ancients, who dreaded the herald of disaster, 'terris mutantem regna cometen,'[2] and held it as a malignant genius that

> —— from his horrid hair
> Shakes pestilence and war.

Those who noticed the fiery hue of the sabre-like comet that passed to the E. at the commencement of the Crimean war will understand with what feelings our fathers would have gazed upon it, like the astonished spectators of the comet of the Norman Conquest, represented in the Bayeux tapestry with the inscription 'isti mirantur stellam:' nor will the exaggeration of those beautiful lines seem unnatural,

> —— liquida si quando nocte cometæ
> Sanguinei lugubre rubent.[3]

It is however certain, both from the Chinese and modern observations, that there is much difference in respect to colour:[4] ℍ even found the nucleus of the same comet (1811) pale ruddy, the envelope greenish or bluish green: and a similar contrast was noted by Struve in Halley's comet in 1835, and by Winnecke in 1862. That the Sun induces in

[1] Seneca.

[2] Lucan. The 'comet-dollars' still existing in Germany are a curious evidence of this feeling as late as 1664. See *Illustr. Lond. News*, July 20, 1861.

[3] Virgil.

[4] This comes out well chemically. The 'Donati' was photographed: with Comet II, 1861, it was found impossible even by De La Rue.

them a polar force superior to that of gravitation—the hypothesis, in the main, of Olbers—is most probable from the form of the envelope and tail, as if repelled alike from the nucleus and Sun: and that a certain portion of the rarer material must be dissipated during the perihelion passage is evident from the very aspect of a tail such as that of 1858, whose restoration to the rapidly advancing nucleus is, to our apprehension, an impossibility. And in this, and in the resistance which comets which traverse the solar corona may be presumed to suffer, we find sufficient indications that our system was not made to be eternal. The perfect balance of its construction might at first lead to another impression, and seem to countenance the old objection, that 'all things continue as they were from the beginning of the creation.' But here is evidence to the contrary—slight, but decisive symptoms that—'they all shall wax old as doth a garment;' that they 'shall be changed.' The traces of dissolution may be perceived in the comet of Biela, whose separation into two parts is one of the marvels of modern astronomy.[1] Single in all previous observed returns (those of 1772, 1805, 1826, 1832), in 1846 it became elongated, and then threw off a portion which increased till it rivalled and even for a short time surpassed its parent, each having at one period a starry nucleus and short tail, while they were connected by faint streams of light: and thus they continued in sight for more than 3 months, keeping a distance of something more than 150,000 miles, the companion being the first to vanish. When next seen by Se., in 1852, the distance was more than 8 times greater, being 2^m in RA, and 30′ in Declination, as though they were becoming independent bodies: their next

[1] Liais at Olinda saw a second smaller and fainter nebulosity on several nights by the side of Comet I, 1860, previous to its disappearance.

favourable return (1866) was looked for with no common interest; but they were not seen, and probably will never again be seen by mortal eye. Nor has the larger comet of De-Vico, discovered by him in 1844, with an apparent period of $5\frac{1}{2}$ years, ever shown itself again—it has

> —— 'wandered away alone,
> No man knows whither.'

The identity of the orbits of two comets (II, 1862; and I, 1866, believed to be the same as that of 1366) with the paths of the meteor-showers in August and November, if it should not prove a premature generalization, is one of the most remarkable of modern discoveries, for which Schi. has received the Gold Medal of the Royal Astronomical Society. It is needless, in a treatise like the present, to make more than a passing allusion to this subject, but as it is of admitted interest, the dates and radiant points of the principal showers will be subjoined in Appendix IV.

PART III.

THE STARRY HEAVENS.

Lift up your eyes on high, and behold Who hath created these things, that bringeth out their host by number: He calleth them all by names by the greatness of His might, for that He is strong in power; not one faileth.
ISAIAH, xl. 26.

DOUBLE STARS, CLUSTERS, AND NEBULÆ.

IF the Solar System had comprised in itself the whole material creation, it would alone have abundantly sufficed to declare the glory of GOD, and in our brief review of its greatness and its wonder we have seen enough to awaken the most impressive thoughts of His power and wisdom. But that system is but as a single drop in the ocean. What boundary may be set to creation we know not, but we can trace it sufficiently to perceive that, as far as our senses are concerned, it cannot be distinguished from absolute infinity: and in leaving our Sun and his attendants in the background, we are only approaching more amazing regions, and fresh scenes will open upon us of inexpressible and awful grandeur. We are now to contemplate not one Sun, but thousands and myriads: not a planetary system of subordinate globes, but aggregations of Suns; pairs, groups, galaxies of Suns—'the host of heaven'—all independent in unborrowed splendour, yet many evidently, and all by clear implication, bound together by the same universal law which keeps the pebble in its place upon the surface of the earth, and guides the falling *drop* of the shower, or the mist of the cataract. Many of

these Suns may probably be smaller or dimmer than our own, yet others unquestionably far surpass his splendour; while as to distance, their remoteness is so inconceivable that light itself, flying with a speed which would encircle the Earth nearly 8 times in one second, only shows them to us as they formerly were, some years, others centuries, others perhaps whole ages back, even in the first dawn of creation. Here is indeed a field where enterprise cannot be thrown away, nor perseverance fail of its reward.

We must, however, remember that, though they are Suns which we are contemplating, and though the mere aspect of some of them in a large telescope well bears out the assertion,[1] yet a great proportion are diminished by distance to the minutest points of light, and can only be distinctly seen under favourable circumstances. We cannot therefore expect uniform success; in fact, the more delicate objects of stellar astronomy are not only among the severest tests of the telescope and the eye, but are peculiarly liable to be affected by atmospheric indistinctness, and require the most propitious skies. The cautions suggested in Part I. will be especially applicable here.

An original investigation of all the objects worthy of notice, even in a popular sense, in the starry heavens, would have been the attempt of a lifetime, rather than of such occasional hours of leisure as I could command: an unverified selection, on paper, from a standard list formed with a very different design, would have been an easy, but not a satis-

[1] The approach of Sirius to the field of H's 40 f. reflector is said to have been ushered in by a dawning light, and its actual entrance to have been almost intolerable to the eye: yet the 4 f. mirror was far from good. What must be the blaze of this star in the Earl of Rosse's telescope, with a speculum of 6 f., of much higher reflective power!

factory task: a middle course has therefore been preferred. All such of the 850 Double Stars and Nebulæ of Vice-Admiral Smyth's Bedford Catalogue as my $3\frac{7}{10}$ in. of aperture could be expected to reach, were examined in succession, and those only retained which seemed to possess sufficient general as well as scientific interest, and might serve as specimens of the universal profusion: but as in such a review a number of other objects, beautiful to the popular eye, though unimportant perhaps to the professed astronomer, presented themselves unsought, many of these have been added to the list, as well as many from Struve's 'Mensuræ Micrometricæ,' and other quarters. Such was the plan of the preceding edition. But the 7 years that have since elapsed have brought such an unprecedented increase of observers and instruments competent to deal with a more difficult class of objects, that it has been thought desirable, without abandoning the original design or title of the work, to enlarge it in the hope of greater usefulness. An addition has accordingly been made of about 1,080 pairs from Lord Lindsay's very valuable Summary of the Dorpat Catalogue, together with 70 from that of Poulkova, and many from the lists of Burnham. The few that I have had an opportunity of reviewing (besides the selection from Smyth), with some original matter, are included in brackets [ ], and the series comprises many notes on colour and magnitude, the permitted publication of which demands special acknowledgment. These may all in their way be helpful to the student. But, if diligent in the employment of opportunities, he will soon find that, as these pages are but a very limited selection from works of the highest character, so those in turn are powerless to represent even what we can reach of the unspeakable richness and grandeur of the firmament. The Dorpat catalogue of 3,062 *double* stars was a wonder of accuracy and perseverance: but

H considered that it included less than $\frac{1}{3}$ of the pairs that were obvious in his sweeping: and a large proportion of these are unrecorded still. And yet the sole, or even the chief attraction of the sidereal heavens does not lie in the juxtaposition of two stars, possibly merely accidental, and frequently beyond the reach of any but the most powerful instruments. Many parts of the sky, especially the crowded fields of the Galaxy, are full of most interesting and beautiful groups and combinations, of which little or no mention can be found. The attention of the professed astronomer is usually directed into some definite channel, and he has little leisure, and sometimes perhaps not much taste, for that general and indefinite sweeping and 'star-gazing,' which to humbler students becomes a source of boundless delight and wonder. It need not be said that the wishes of the latter class have been chiefly considered in the following pages, though it is hoped they may be of occasional use in other ways.

From a pressure of various employments, the interval since the first appearance of this little work has not added much original matter to the following catalogue. But it is to be hoped that some zealous lover of this great display of the glory of the Creator will carry out the author's idea, and study the whole visible heavens from what might be termed a picturesque point of view. This would involve nothing more than a sufficiency of optical power, of leisure, and of patience bringing with it its abundant reward. By a suitably arranged plan, every part of the sky might be swept over in succession, and the principal instances of intensity of colour, or elegance or singularity of grouping having been noted, the materials would be prepared for a most interesting work—a *Handbook of the Wonders and Beauties of the Starry Heavens.*

A well-adjusted equatorial telescope will readily find anything in the following list from the position there given,

otherwise, recourse must be had to a good globe or map. The larger Star-Maps of the Society for the Diffusion of Useful Knowledge were very carefully compiled and of much value in their day, notwithstanding a most inconvenient amount of distortion towards the sides and corners; but in this respect, though not as regards the minuter stars, they are much inferior to the Atlases of Proctor; the smaller of these was specially intended as a companion to the present work, but does not contain the additions made in this impression. The stars, clusters, and nebulæ in the following pages are divided into constellations, which are arranged alphabetically and accord with those in the Bedford Catalogue: the boundaries of Heis, in his 'Atlas Cœlestis,' have been followed; but difficulties have often arisen as to objects close on the borders, and they may have been occasionally assigned to a wrong constellation.

In the arrangement of the double stars in each constellation, precedence is given to brightness in the larger star of each pair, though great exactness in this respect has not been aimed at, and, from the uncertainty of magnitude-estimates, would hardly have been attainable. The additions from Struve are separately arranged on the same plan. Pairs whose connection is ascertained are termed 'binary.'[1] The various data of each separate object have been taken in all cases from the catalogue whence it is derived: the inconvenience arising from the use of different scales in different parts has been avoided by adding, throughout the double stars from the Bedford Catalogue, the magnitudes of Lindsay's summary of Struve to those of Smyth, that is of Piazzi

[1] It should be observed that where change is demonstrated it does not necessarily infer binarity, as it may arise from proper motion *in* one or both of the components; and binarity is proved by *common* proper motion where no other change can be detected.

in his Palermo Catalogue for the larger star in each pair. It will be seen that Smyth uses no divisions smaller than half a magnitude, while those of Struve, including in 12 degrees the 20 of H, are decimally divided.

I am indebted to the kindness of G. Knott, Esq., for the following table of the equivalent telescopic star-magnitudes of Smyth, Struve (Σ), Herschel II, and Argelander. It is the result of direct comparison of their respective values of the same objects: those of Argelander being carried below 9·5m^g. by inference.

Sm.	Σ	H.	A.
6	5·7	6·4	5·9
6·5	6·3	7·0	6·4
7	6·5	7·4	6·8
7·5	6·9	7·8	7·5
8	7·4	8·2	8·0
8·5	7·9	8·8	8·6
9	8·3	9·5	9·0
9·5	8·9	10·1	9·4
10	9·3	10·4	9·4
11	10·0	11·3	10·0
12	10·4	11·7	10·6
13	10·7	12·5	11·2
14	10·9	13·3	11·8
15	10·9	14·5	12·4
16	10·9	15·9	13·0

A subsequently published collation by Herschel II. of his own magnitudes with those of Σ will form an interesting addition.

Σ	H.	Σ	H.	Σ	H.	Σ	H.
2·60	3	6·40	7	9·30	11	10·87	15
3·10	3·5	6·85	7·5	9·60	11·5	11·13	16
3·60	4	7·30	8	9·80	12	11 38	17
4·10	4·5	7·70	8·5	10·00	12·5	11·61	18
4·60	5	8·10	9	10·18	13	11·82	19
5·05	5·5	8·50	9·5	10·36	13·5	12·00	20
5·50	6	8·80	10	10·54	14		
5·95	6.5	9·10	10·5	10·71	14·5		

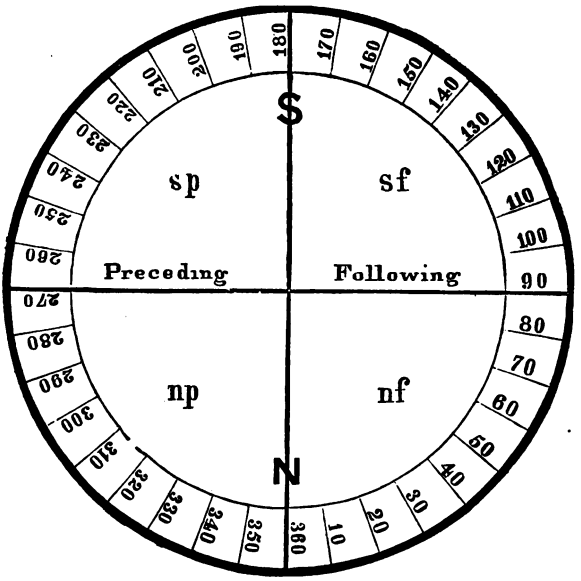
The whole subject of magnitudes is, however, in an uncertain and unsatisfactory state; an assertion which will be borne out by a collation of the best authorities with each other, with themselves on different occasions, and with the sky; and it is with pleasure that we find that stellar photometry is being seriously taken in hand with the best appliances at the Harvard Observatory.

The *range of visibility* is limited not only by the light of the instrument and the sensitiveness of the eye, but to an extent that could not have been anticipated, by the condition of the air. Burnham has remarked that 'an object-glass of 6 in. one night will show the companion to Sirius perfectly: on the next night, just as good in every respect, so far as one can tell with the unaided eye, the largest telescope in the world will show no more trace of the small star than if it had been blotted out of existence.' Burnham, Ward, Sadler, and others possess a sight capable of detecting very minute points with small optical means, but with an eye and telescope of average quality my experience leads me to believe that the range of a $3\frac{7}{10}$ in. object-glass will terminate among 11 m^{g}. stars (of Smyth's scale), though from some unknown cause—possibly, as Smyth suggests, peculiarity of hue—smaller ones are sometimes to be caught. Where I have ventured to note any discrepancy as to magnitude, it has been with a view to assist in detecting variations of light: Schr. suggested, and Humboldt is of his opinion, that variability may be the inseparable condition of all light, and the evidence of its probability is continually on the increase. As to estimates of *colour* there is also great uncertainty, arising from the differences of telescopes and eyes, and even of the states of the same eye: still there are limits of disagreement, and it is desirable to fix them, as there seems reason to believe that these colours may change: where there is any such

suspicion, comparisons should be multiplied, and their circumstances varied. As this is an interesting enquiry, and one suited to amateurs, I had intended to insert many more discrepancies between Smyth's colours and those of other observers; but I ultimately found that a very large proportion may be reasonably referred to the causes just mentioned, and included in the wide margin of those individual peculiarities of perception or judgment which astronomers term 'personal equation,' so that a few only have been retained, either where there may be some suspicion of real alteration, or as specimens of the differences to be expected in the enquiry. I have ventured to pass by, from their obvious peculiarity, Sestini's colours, which caused a re-examination by Smyth, published in his learned and elegant 'Ædes Hartwellianæ,' but I have inserted some by the eminent observer Dembowski, as worthy of the highest confidence; and, in the present edition, many by modern observers. The colours of all the objects in my list, as well as many others, were carefully compared with the Bedford Catalogue: my original instrument and experience were far inferior,[1] and my eye usually biassed by previous knowledge, so that I was little qualified for such a scrutiny; but with a great preponderance of agreement or acquiescence, a few discrepancies were noted: dates are added, as the idea of periodical changes of tint involves no impossibility, and has been strongly advocated by Piazzi Smyth. The subject is a curious one, and it would be worth while to record from time to time the colours not only of associated but single stars as they may come under our

[1] The subsequent great advantage of a 9½-in. silvered mirror has been less apparent here than in other respects. My experience concurs with that of Browning, who finds colour decrease with increasing aperture, so as to render stops serviceable, and of Huggins, to whom colour is imperceptible in too much or too little light.

notice. The *angles of position*, which measure the inclination to the meridian, of the line joining the stars, are given in degrees, with the first decimal. The following diagram, in which the direction of passage through the field is indicated, will sufficiently explain the mode of measurement; the larger being always considered as the central star. The *distances*



between the stars (always from centre to centre) are given from Smyth (or Struve for his own objects) to seconds with the first decimal place.

After Binary and Double Stars are placed the most striking Red Stars in Birmingham's catalogue, and all the variables in that of Schönfeld; then follow such Clusters

and Nebulæ as are most conspicuous in a host of about 5,400. Many of the great wonders are altogether beyond the 'common telescopes' of former years, but the unprecedented extension of optical power among amateurs has induced me to add to the previous list about 50 objects from the catalogue of H which I have had no opportunity to examine, but which I believe will be found worthy of attention. These are included in parentheses, ( ).

The Right Ascensions and Declinations have been brought up to 1880, by correcting for the Precession of the Equinoxes, which, by slowly carrying round the artificial network of meridians and parallels in front of the immovable heavens, is continually changing the *nominal places* (not the *relative positions*) of the stars. The nearest minute of time and space was thought a sufficient degree of accuracy in this computation: but even this could not always be attained where authorities differ; and no greater correctness is guaranteed than will answer the purpose of *finding* in a moderate-sized field. Globes and maps, admitting of no such reduction, will require mental allowance on this account in proportion to their date.

As to optical management: close pairs and crowded clusters gain by increasing the power; so *in general* do dissimilar colours, and very minute points near larger stars; but experience will be the best guide. For difficult pairs we should follow HJ's advice, and adjust the focus previously upon a single star of nearly the same altitude, size, and colour; the peculiar aspect of the double star will be afterwards more striking. Occasionally a slight change, especially lengthening, of focus may relieve a weary eye. In estimating colours, keep near the centre of the field: its edges may not be achromatic. Large nebulæ always require low powers; very small ones must be more magnified to show their nature, and

resolvable ones, to insulate their sparkling points. In most cases low powers have the advantage from the beauty and variety of their broad fields. The magnifiers used by myself with $3\frac{7}{10}$ inches ranged from 64 to 250, in a few instances 300.

In the following list, under the head of Double Stars, the *Synonym*, which stands first, is either a Greek letter, which is Bayer's designation; an Arabic numeral, which (unless otherwise specified) is Flamsteed's; or a compound title referring to Piazzi's Catalogue, in which **P** indicates the observer's name, and the Roman numerals the hour of Right Ascension;[1] to these are added in parenthesis, where practicable, an Arabic numeral preceded by Σ (the conventional symbol for the name of Wilhelm Struve), which refers to the great Dorpat Catalogue of Double Stars, and those numerals are followed, for uniformity and comparison's sake, by the mean magnitudes given from that observer by Lindsay. In the class of Clusters and Nebulæ, the prefixed number is that in the General Catalogue of Sir J. Herschel (1864); to which is subjoined, either M, followed by a numeral referring to Messier's Catalogue of Nebulæ in the 'Connoissance des Temps' for 1783 and 1784; or Ħ, the Roman numeral after which shows the class in the catalogues of that observer. After the Synonym comes the *Place in the Heavens*, given first in hours and minutes of Right Ascension, then in degrees and minutes of Declination, marked N or S, as the case may be; the Italic letters, *n* (north), *s* (south), *p* (pre-

[1] The student will hardly need to be reminded that Piazzi's numbers require the hour to be specified, and that as they merely express sequence in R.A. they give no intimation of the constellation in which the stars are to be found. They are taken from the Palermo Catalogue of 7,646 stars, published in 1814, the result of nearly 150,000 observations, and requiring 30,000,000 figures for their reduction.

ceding), and *f* (following), being employed to indicate the relative positions of neighbouring objects. Next are placed (in the case of Double Stars) the *Magnitudes* in corresponding Arabic numerals separated by a comma; the half-magnitudes being expressed by the decimal point and figure ·5 (the magnitudes of other observers are often carried to minuter divisions). Then follow the *Position-angles*, the *Distances*, and the *Colours*; with occasional remarks from other authorities. After these come the additions from Struve, his son, and Burnham, with their own data; other notices from various quarters; and, finally, the Nebulæ and Clusters.

All data, not included by ( ) or [ ], or referred expressly to other sources, are taken from the Bedford Catalogue or its revision in the Speculum Hartwellianum; for many descriptions of objects, and directions for finding them, the author is responsible.

Abbreviations (additional) and Symbols:—A., *Argelander;* B., *Birmingham;* Bu., *Burnham;* d'A., *d'Arrest;* De., *Dembowski;* Do., *Doberck:* Du., *Dunér;* Es., *Espin;* F., *Flamsteed;* Fl., *Flammarion;* Fr., *Franks;* Gl., *Gledhill;* K., *Knott;* Ll., *Lalande;* M. *Messier;* OΣ., *Otto Struve;* P. Sm., *Piazzi Smyth;* Sa., *Sadler;* Wa., *Ward.*—Bin., *binary;* c. p. m., *common proper motion;* var., *variable;* v., *very;* bl., *blue;* blsh., *bluish;* grn, *green;* grnsh., *greenish;* or., *orange;* yel., *yellow;* yelsh., *yellowish;* wh., *white,* &c.

ANDROMEDA.

This constellation is rich in interesting objects of every class; on the meridian, however, it is inconveniently high for an achromatic telescope, and should therefore be examined some hours E. or W. of it, like many other similarly situated regions. Its upper part towards the Galaxy contains very fine sweeping.

Double Stars.

γ (Σ 205 : 3,5). $1^h\,57^m$, N 41° 45′ : 3·5, 5·5 : 61°·6 : 11″ : (Du 10″·1 ; Gl 10″) : deep yellow, sea-green. One of the most beautiful pairs in the heavens, though probably stationary, and devoid of the interest of a binary system. It seems to have been first noticed by C. Mayer in 1778. In 1842 OΣ found the companion double; so close that common telescopes will not even elongate it (though it has been done with 4¼ in. Cooke) and the finest only can divide it. This has been effected under exceptional circumstances with a 5 in. object-glass : 8 in. were formerly certain. With's and Calver's 6½ in. mirrors would split it some years back, and those of 8½ in. were guaranteed to do so in steady air; but notwithstanding OΣ's opinion it is becoming still more difficult.

Considerable and unaccountable discrepancy as to m^s : 5·5, 6·8 have been thought probable : variation has not been suggested. Murray, D, and Jacob have noticed difference in colour, yel., bl. ; Fl gives grn., bl. ; Fr bl., yelsh. D 125°·5 : 0″·4, 1842 ; K 107°·1 : 0″·6, 1865 ; Hall 101°·8 : 0″·4, 1877 ; so Bu 1878. Evidently bin.[1]

μ. $0^h\,50^m$, N 37° 51′ : 4, 16 : 115° : 45″ : wh., dusky grey. Inserted as light-test; depending however, like others, mainly on atmospheric conditions. 16 seen but once in many trials by Sm, when μ was hidden by a bar. D, who rated it 11½ or at most 11¼ of Σ's scale, glimpsed it with 4·8 in. of 8 in. achr., even when his vision was slightly impaired. Wa has seen it with $4\frac{3}{10}$ in achr. I held it pretty steadily

[1] In examining such test-objects, it is important to note the difference between one long disc crossed by a dark interference-line, which is sometimes called division, and two round discs with black *sky* between them.

[ANDROMEDA]

in the presence of μ with $9\frac{1}{3}$ in. spec., so Fr. with 5 in. achr. Buffham glimpsed it with $6\frac{1}{2}$ in. of 9 in. spec.

π. $0^h\ 30^m$, N 33° 4′: 4·5, 9 (Grover 9 under-rated): 173°·9: 35″·6 wh., bl. Fr sees pair 5^m *p*: 6, 9: yel., bl.

56, P I 203. $1^h\ 49^m$, N 36° 40′: 6, 6: 302°·4: 176″: yel., 1834; Σ (4 App. I) *p* smaller and always deeper in colour, 1836; [*p* larger and ruddier, 1850; nearly equal, *p* redder, 9 in. spec. 1871]. Whitley *p* smaller, yel., or., 1869; Fr *p* smaller, 1876. Specimen of a class whose similarity, though far apart, always gives the impression of physical connection; more clearly deduced in this case from 'common proper motion' through space. Nearly pointed at by γ and β Triang. at about twice their distance. Grover notices fine field, 30′ *nf*.

36 (Σ **73**: 6·2, 6·8). $0^h\ 49^m$, N 22° 59′: 6, 7: 315°·7: 1″·1, 1835 (Se 349°·5: 1″·3, 1866; De 356°·2: 1″·3, 1877): bright or., yel. Bin., Do 349 y. Beautiful and not difficult object. Closely *n p* η towards ζ: visible to naked eye.

59 (Σ **222**: 6·7, 7·2). $11^h\ 4^m$, N 38° 28′: 6, 7·5: 34°·7: 16″·3: blsh. wh., 1835 [yelsh. wh., 1850, 1855], pale viol.; Σ v. wh., 1831. [Not more than 1 m^s. diff., 1850, 1855, 1862, 1871 (9 in. spec.): so De 1858, Grover 1874.] Grover neat pair 10′ *np*: 9, 10: est. 140°: 12″.

P II 61. $11^h\ 15^m$, N 40° 51′: 7, 11: 355°: 50″: yel. pale lilac. I failed to see the companion, 1851 (Fr less than 11, 1876), but the object guides to a pretty open 8 m^s. pair, one of which is P II 62. Field fine with low power. About $\frac{1}{3}$ from γ towards Algol.

P O 175, 176 (Σ 1 App. I: 6·7, 6·7). $0^h\ 40^m$, N 30° 17′: 8, 8: 235°·8: 46″·4: pale yel. Fr *p* deeper, 1876. Curious similarity. $1\frac{1}{2}°$ *f* δ. Grover small wide pair 35′ *np*.

22. $0^h\ 4^m$, N 45° 24′: 5: wh., 1838 [clear yel., 1850].

[ANDROMEDA]

Guide to an elegant pair Σ **3** (7·5, 8·5), nearly *n* : 8, 9 : 84° : 4″·9 : pale yel., blsh. (Σ both wh.).

P XXIII 240 (Σ **3048** : 7·7, 8·8). XXIII^{h} 52^{m}, N 23° 41′ : 8·5, 9 : 313°·9 : 9″·4 : pale wh., yelsh., 1833; [1 m^{s}. diff. 9 decidedly bl., 1850; 8, 10 : bl. ? a 12 m^{s}. *comes*, 9 in. spec. 1871.] Fr quite 2 m^{gs}. diff. 1876; Grover 9 beautiful bl., 1874.

Σ **3050**. XXIII^{h} 53^{m}, N 33° 4′ : 6,6 : 191° : 3″·8, 1832 (Do 202°·2 : 3″, 1876) : yelsh. (Fl bin?).

Σ **79**. o^{h} 53^{m}, N 44° 7′ : 6,7 : 192°4 : 7″·6 : v. wh., blsh. wh.; [7 grnsh., 9 in. spec. 1871; so Fr 1876. Very beautiful.]

Σ **228**. II^{h} 6^{m}, N 46° 56′ : 6·7, 7·6 : 262°·1 : 1″·1, 1831, De 313°·5 : 0″·6, 1876) : wh. (Rapid bin. Test-object.)

Σ **179**. I^{h} 46^{m}, N 36° 44′ : 6·7, 7·7 : 160°·4 : 3″·5 : wh., 1831; Fr 7·7 blsh., 1876.

Σ **47**. o^{h} 34^{m}, N 23° 23′ : 6·7, 8·6 : 204°·7 : 16″·6 : wh., o.

Σ **40**. o^{h} 29^{m}, N 36° 10′ : 6·8, 8·8 : 312°·2 : 11″·6 : yel., ash.

OΣ **2**. o^{h} 7^{m}, N 26° 19′ : 6·9, 8·3 : 43°·8 : 0″·9 : o, o.—Triple; 9·6 : 226°·2 : 17″·8.

Σ **3042**. XXIII^{h} 46^{m}, N 37° 14′ : 7,7 : 89°·3 : 4″·2 : v. wh. (Fr yelsh., 1876).

Σ **162**. I^{h} 42^{m}, N 47° 19′ : 7, 7·5 : 225°·5 : 1″·9 : v. wh.—Triple; 9·7 : 179°·5 : 20″·4. (Bird, dark bl.)

Σ **245**. II^{h} 11^{m}, N 39° 44′ : 7, 8 : 291°·8 : 11″ : yelsh. wh., blsh. wh.

Σ **2985**. XXIII^{h} 4^{m}, N 47° 19′ : 7, 8 : 252°·1 : 15″ : yelsh. wh., blsh.

Σ **24**. o^{h} 12^{m}, N 25° 30′ : 7·2, 8 : 248°·4 : 5″·2 : wh. *[A pretty pair.]* Bird minute *comes s.*

[ANDROMEDA]

Σ 3058. XXIII^h 59^m, N 29° 42′ : 7·7, 9·2 : 49°·9 : 12″·5 : wh., o.

Bu **398.** 1^h 5^m, N 47° 10′ : 8, 8 : est. 60° : 2″.

Σ 154. 1^h 38^m, N 43° 7′ : 8, 8·2 : 126°·7 : 5″·2 : v. wh.

Σ 141. 1^h 33^m, N 38° 22′ : 8, 8·5 : 300°·6 : 1″·7 : yelsh.

Σ 3010. XXIII^h 18^m, N 45° 9′ : 8, 8·7 : 132°·4 : 25″·3 : yelsh.

Σ 55. 0^h 38^m, N 32° 58′ : 8, 8·8 : 322°·9 : 2″·1 : wh.

Σ 52. 0^h 38^m, N 45° 37′ : 8, 9 : 25°·8 : 1″·4 : yelsh., o. (Fl bin.)

Σ 72. 0^h 48^m, N 38° 32′ : 8, 9 : 182°·3 : 24″·3 : yelsh.

Σ 17. 0^h 10^m, N 28° 39′ : 8, 9·2 : 29°·3 : 26″·3 : yelsh., o. [In a wide sprinkle.]

Σ 33. 0^h 25^m, N 33° 26′ : 8·2, 8·3 : 205°·5 : 2″·5 : wh.

Σ 251. 11^h 14^m, N 38° 50′ : 8·2, 9 : 264°·9 : 2″·2 : yelsh. wh.

Σ 3024. XXIII^h 26^m, N 43° 10′ : 8·2, 9 : 311°·6 : 4″·9 : wh.

OΣ 547. XXIII^h 59^m, N 45° 9′ : 8·3, 8·3 : 110°·9 : 4″·5 : redsh.—Bin. c. p.m.

Σ 44. 0^h 32^m, N 40° 20′ : 8·3, 9 : 258°·8 : 7″·9 : yelsh.—Gl moving.

Σ 3043. XXIII^h 47^m, N 38° 2′ : 8·4, 9·2 : 250° : 15″·5 : wh.

Σ 195. 1^h 53^m, N 43° 54′ : 8·5, 8·8 : 194°·6 : 3″·1 : wh.

Σ 250. 11^h 14^m, N 36° 52′ : 8·5, 9 : 135°·8 : 3″·2 : wh.

Σ 112. 1^h 13^m, N 45° 43′ : 8·5, 9 : 327°·2 : 23″·6 : yelsh. wh.

Σ 140. 1^h 32^m, N 40° 29′ : 8·5, 9·2 : 172°·3 : 3″·3 : wh.

Σ 3113. 1^h 47^m, N 44° 0′ : 8·7, 8·7 : 270°·5 : 1″·5 : o, o.

Σ 248. 11^h 14^m, N 42° 14′ : 8·9, 8·9 : 161° : 1″·6 : yelsh.

[ANDROMEDA]

Red Stars.—B 4. $0^h\ 14^m$, N 44° 3′ : 8·2.

B. A. C.[1] **8245.** $\text{XXIII}^h\ 36^m$, N 44° 20′ (45′ *nf* κ) 7, var? or. red. Fr 1877.

Var.—R. $0^h\ 18^m$, N 37° 55′ : 5·6, 8·6—below 12·8 : 402^d, shortening.

Nebulæ and Groups.

116 (M 31). $0^h\ 36^m$, N 40° 35′. One of the grandest in the heavens; long, oval or irregularly triangular, ill-bounded, and brightening to the centre; so plain to the naked eye that it is strange that the ancients scarcely mention it.[2] By moving the telescope rapidly to gain contrast, Bond extended it to the surprising dimensions of 4° in length and 2½° in breadth, of which common instruments show little, and less in proportion to the increase of power. No telescope has been able to deal with its nature; Bond's $14\frac{18}{20}$ in. achr. found no resolution, though it was seen through a rich stratum containing above 1,500 stars. It detected, however, two curious dark streaks, like narrow clefts, both beyond any ordinary instruments, in which the darker of them forms in reality the boundary of one side of the nebula as seen with a small aperture: both were well seen by Se with $9\frac{6}{10}$ in. achr.: I have caught one with difficulty with 5½ in. achr., 1863: Grover has seen both with 6½ in. silvered mirror, and I have traced them through a long extent with 8 in. mirror (With), 1864; but this was *after the knowledge of the fact*, which has a great influence upon the eye; the truth of Hll's remark being often exemplified, that less optical power will

[1] British Association Catalogue.

[2] It is however referred to as a familiar object by the Persian astronomer, Sûfi, in the tenth century.

[ANDROMEDA]

show an object than was required for its *discovery*. Huggins finds spectrum continuous, but cut off at the red end. It seems, therefore, not gaseous : if stellar, it is strange that, comprising such extremes of feebleness and condensation, it can be resolved with certainty nowhere, the nucleus only, of about 7″, showing a granular texture in great instruments. There is some deep mystery here.

117 (M 32) is in the same field with a low power ; small, but bright ; resolved into stars by the E. of Rosse's 3 f. speculum and Buffham's 9 in. (With). Spectrum like that of M 31.

105 (H V 18). $0^h\ 34^m$, N 41° 1′. Large faint oval neb. best with low power ; resolved by Bond : a very large field includes it with 116 and 117.

[4964 (H IV 18). $23^h\ 21^m$, N 41° 52′. Small, but very bright. La sees nucleus and 2 oval rings : E. of Rosse, a spiral structure. My $9\frac{1}{2}$ in. spec. shows blsh. disc with wooly border and suspicion of dark centre. Huggins, 8 in. achr. annular, grnsh. bl. ; spectrum of 4 gas lines —nitrogen, hydrogen? To find it, sweep 24^m *f* from *o*, 4 m^g.]

[218 (H II 224). $1^h\ 3^m$, N 35° 4′. Rather faint ; but easy with $9\frac{1}{2}$ in. spec. *n p β*, 2 m^g. strong yel. in the same field. d'A strong nucleus. E. of Rosse resolvable.]

(575 (H I 156). $11^h\ 33^m$, N 38° 33′. One of H's bright-class neb^s., lenticular, 5′ long, with stellar nucleus.)

[457 (H VII 32). $1^h\ 50^m$, N 37° 5′. Wide rich region, especially of small stars.]

[Pretty group, ± $1^h\ 16{\cdot}5^m$, N 38° 15′.]

ANSER.

This little modern asterism, numbered as part of Vulpecula, does not contribute many interesting pairs; but the two following, among many other fields, will give pleasure to all who seek out the glories of creation.

[α (6), 8. XIX^h 24^m, N 24° 25′: 4, 5: deep and pale yel., in beautiful field, 3° nearly s from β Cyg.]

[4, 5, 7, &c. XIX^h 20^m, N 19° 34′. A magnificent region.]

Σ 2504. XIX^h 16^m, N 18° 57′: 6·4, 8·1: 288°·3: 8″·9: yelsh. wh., blsh.

Σ 2457. XIX^h 2^m, N 22° 24′: 7·2, 8·7: 201°·3: 10″·1: wh., o.

Σ 2523. XIX^h 22^m, N 20° 57′: 7·3, 7·4: 151°·5: 6″·2: v. wh.

Σ 2540. XIX^h 28^m, N 20° 9′: 7·5, 9: 149°·7: 5″·1: wh., blsh.

Σ 2548. XIX^h 32^m, N 24° 45′: 8, 9: 100°·8: 9″·3: wh.

Σ 2499. XIX^h 13^m, N 21° 46′: 8·1, 8·4: 324°·9: 2″·6: v. wh.

Σ 2584. XIX^h 43^m, N 21° 55′: 8·5, 8·5: 299°·2: 1″·9: wh.

Σ 3111. XIX^h 20^m, N 21° 36′: 9, 9·3: 120°·1: 2″·5: o, o.

ANTINOUS.

A constellation now usually thrown into Aquila.

Double Stars.

P XX 26 (**Σ 2644**: 7·1, 7·4). XX^h 7^m, N 0° 31′: 6·5,7: 207°·9: 3″·5: wh., 1832; De 7, 7·2: wh., grn., 1853–4; *Se 7, 7·2*; wh., blsh., 1855 [nearly equal, 1850, *n* a little

[ANTINOUS]

larger with power 144; 8·3, 8·6, 9 in. spec. 1871]; Sa 8, 8·25, 1875; Fr nearly equal, 1876. Se K slow angular motion. 2° *n* of θ, a little *f*.

P XX 140, 139. $xx^h\ 22^m$, S 2° 30′ : 7·5, 8 : 191° : 59″·6: wh., 1833 [wh., grey, 1850, 1855; so Sa 1875; Fr pale yel., greyish wh., 1876]. Each has a faint companion, and Sm glimpsed a 5th. Field, if large, very fine.

P XX 116 (Σ **2677** : 6, 10·5). $xx^h\ 18^m$, N 0° 39′ : 7·5, 12 : 28° : 30″ : wh., grey. Sm says the companion is 'so minute that its distance is only an estimation.' I saw it steadily with $3\frac{7}{10}$ in., a good test; an isos. triangle with θ Antin. and 69 Aquil. the *s* of two 7 m^g. stars; the other, P XX 117 : fine or.

P XX 12. $xx^h\ 5^m$, S 0° 29′ : 8, 9 : 202°·2 : 54″·2 : pale grey, 1835 [yelsh., blsh., 1850, 9 in. spec. 1871;—so Sa 1875, Fr 1876]. 1° *n* of θ.

P XVIII 274, 275 (Σ **2434** : 7·9, 8·4). $xviii^h\ 57^m$, S 0° 53′ : 9, 9 : 146°·8 : 25″·6, 1838 (Gl 133°·2 : 23″·8, 1874) : wh. [*s f* considerably the smaller, 1850, 1871]. A 16 m^g. (Σ 10·3m^g.) star at 1″·5 forms a rapid bin. : I have not seen it. O. Stone 63°·3 : 1″·6, 1877. Bu easy, 6 in. achr.

(37. $xix^h\ 29^m$, S 10° 49′ : 5·5, has within about 1° *f*, 30′ *n*, 3 pairs, Σ **2541** (P XIX 185). 8·2, 9·8′ : 340° : 2″·8 : yel., o. Gl moving. (Es triple; 12 : est. 153° : 8″.)—Σ **2545**. 6·2, 8·1 : 315°·2 : 3″·5 : wh., bl., with distant *comes*, var ?—Σ **2547**. 7·7, 9 : 332°·3 : 20″·7 : wh. and a star with minute double *comes np* Σ **2545**.—Qu. identification ?)

[Triple. 26, $xix^h\ 14^m$, S 5° 39′, 5 m^g. A (Heis 6·5) serves as guide to a delicate and very beautiful triplet $2^m\ 25^s$ (or 36′ of arc) *f*: 7·5 : or., with 2 bl. companions, 11, 12 : close together *n* a little *p*.]

[ANTINOUS]

Σ **2654.** $xx^h\ 9^m$, S 3° 52′ : 6·2, 7·7, 1826 [8, 9, 1855] : 233°·9 : 13″·9 : wh. [yel ? bl ?] Fr yelsh., bl. 1876.

Σ **2425.** $xviii^h\ 54^m$, S 8° 16′ : 6·9, 7·7 : 183°·2 : 32″·1 : yelsh., ashy.

Σ **2533.** $xix^h\ 24^m$, S 0° 39′ : 7·2, 9 : 212°·2 : 23″·2 : v. wh., o.

Σ **2369.** $xviii^h\ 38^m$, N 2° 29′ : 7·5, 8 : 98°·2 : 1″·5 : wh.

Σ **2591.** $xix^h\ 47^m$, S 6° 19′ : 7·5, 8·5 : 108°·6 : 29″·2 : yelsh. wh., wh.

Σ **2661.** $xx^h\ 13^m$, S 2° 37′ : 7·5, 8·7 : 342°·4 : 24″·3 : wh. (Fr 8·7 : lilac, 1876.)

Σ **2519.** $xix^h\ 22^m$, S 9° 46′ : 8, 8·1 : 124°·2 : 11″·2 : v. wh.

Σ **2589.** $xix^h\ 46^m$, N 0° 20′ : 8, 8·4 : 297°·6 : 5″·1 : v. wh.

Σ **2439.** $xviii^h\ 58^m$, S 7° 21′ : 8, 9 : 199°·5 : 22″ : wh.

Σ **2537.** $xix^h\ 27^m$, S 4° 23′ : 8·3, 8·7 : 130° : 19″·1 : yelsh. wh., wh.

Var.—η. $xix^h\ 46^m$, N 0° 42′ : 3·5—4·7 : $7^d\ 14^h\ 4^m$; 57^h increase, 115^h decrease; not quite regular.

Cluster.

4437 (M 11). $xviii^h\ 45^m$, S 6° 24′. Noble fan-shaped cl. 'magnifica innumerabilium stellarum coacervatio' (d'A); at the upper edge of the broad luminous cloud which marks the Shield of Sobieski. Sm compares it to a flight of wild ducks. H stars 11 m^g. divided into 5 or 6 groups [noted independently with 5½ in.]. An 8 m^g. star is a little within its apex; an open 8 m^g. pair $s\,f$ beyond it. H just visible to naked eye. Sometimes placed in Clypeus Sobieskii.

AQUARIUS.

A dull-looking constellation, but well repaying telescopic research.

Double Stars.

β. XXI^h 25^m, S 6° 6′ : 3, 15 : 320° : 25″ : pale yel., bl. Most difficult. [Scarcely suspected, $3\frac{7}{10}$ in. Wa considers it test for $4\frac{1}{2}$ to 5 in. achr.]

ζ (Σ **2909** : 4, 4·1). XXII^h 23^m, S 0° 38′ : 4, 4·5 : 356° : 3″·6, 1831; 346°·9 : 3″·2, 1852 (D 336°·3 : 3″·3, 1866; Do 334°·4 : 3″·6, 1878) : flushed wh., creamy. A very fine object; two suns revolving, Sm thinks, in a period of 750 y.; Do 1625 y. Easy with very small aperture. In centre of triangle of nearly equal stars, all easy to naked eye.—44^g *f*, 11′ *s* Bu finds pair 8·5, 10 or 11 : 1″·5.

12 (Σ **2745** : 5·6, 7·7). XX^h 58^m, S 6° 18′ : 5·5, 8·5 : 191° : 2″·8 : creamy wh., light bl. Brightest of vicinity.

ψ^1 (Σ 12 App. II : 4·5, 8·5). XXIII^h 10^m, S 9° 44′ : 5·5, 9 : 310°·5 : 49″·5 : or. or topaz yel., sky bl. Σ suspects c. p. m.

107. XXIII^h 40^m, S 19° 21′ : 6, 7·5 : 141°·8 : 5″·5 : wh., purpsh., 1850; Se red, bl., 1855. P Sm thinks cols. var. Bin.?

29. XXI^h 56^m, S 17° 32′ : 6, 8, 1830 : 242° : 4″·5 : wh., blsh. [Very little differ. in size, 8 perhaps the smaller, 1849, 1851–3–5; 0·3 m^g. smaller, 9 in. spec. 1871; Howe (Cincinnati) 6, 6·2, 1877.]

41. XXII^h 8^m, S 21° 40′ : 6, 8·5 : 119°·4 : 4″·8 : topaz yel., cerul. bl. A 7 m^g. star (9 m^g. Ll.) to which Bu gives a very minute *comes*, est. 270° : 10″, makes it a pretty group.

94 (Σ **2998** : 5·2, 7·2). XXIII^h 13^m, S 14° 7′ : 6, 8·5 : 345°·4 : 14″ : pale rose, light emerald, 1838; or., flushed bl., 1850. Σ ascribes c. p. m. to this beautiful pair.

[AQUARIUS]

r^1 (Σ **2943**: 6, 9·2). XXII^h 41^m, S 14° 41′: 6, 9·5: 113°·5: 29″·7: (De 114°·6: 28″·5, 1864): wh., pale garnet.

53. XXII^h 20^m, S 17° 21′: 6·5, 6·5: 301°·5: 9″·9: pale wh.; Fr *sf* rather the brighter, 1876. Fl c. p. m.

P XXII 200 (Σ **2935**: 7, 7·8). XXII^h 37^m, S 8° 56′: 7, 8·5: 313°·8: 2″·7: wh., 1833, 1838 [8·5 grey or blsh.? 1850; so Se, 1855; Fr yelsh., blsh. 1876. $2\frac{1}{2}°$ *p* λ, a little *s*.]

P XXII 219 (Σ **2944**: 7, 7·5). Triple. XXII^h 42^m, S 4° 51′: 7·5, 8, 9: 247°·4, 158°: 4″·2, 55″·1, 1835 (Bu 252°·8, 140°·8: 3″·9, 48″·6, 1877): yel., two flushed wh. Bin.

Σ **59**^{1} (83, 84). XXII^h 59^m, S 8° 12′, 5·6, 7: 146°·2: 262″·1: yelsh., yel.

Σ **2809**. XXI^h 31^m, S 0° 55′: 6, 8·4: 163°·5: 31″·1: wh., o. [*f* M 2, a little *n*.]

Σ **2838**. XXI^h 48^m, S 3° 51′: 6, 8·8: 185°·2: 21″·6: yelsh. o, 1829. [8·8 more like Sm's 10, and pale lilac, 1875. Curious and beautiful stream of small stars, *n p*.]

Σ **2993**. XXIII^h 8^m, S 9° 35: 7, 7·8: 177°·9: 25″·6: wh. [Field interesting.]

Σ **3008** (P XXIII 69). XXIII^h 17^m, S 9° 7′: 7, 8: 273°·3; 7″·5: yelsh., ashy. (7^m *f*, 37′ *n*, from ψ^1.) Moving.

Σ **2913**. XXII^h 24^m, S 8° 43′: 7, 8: 331°·9: 8″: wh., redsh., 1830. [9, 10 of Sm's scale, 9 in. spec. 1871.] (Fr 8 purpsh.: 8, 9, 1879.)

Σ **2988**. XXIII^h 6^m, S 12° 33′: 7·2, 7·2.: 281°: 3″·7: yelsh.

Σ **2847**. XXI^h 52^m, S 4° 4′: 7·6, 8: 296°·6: 1″·2: yelsh. (Bin. ?)

Σ **2862**. XXII^h 1^m, S 0° 1′: 7·6, 8: 104°: 2″·3: yelsh., yel.

Σ **2995**. XXIII^h 10^m, S 2° 15′: 7·7, 8: 26°·7: 4″·6: wh.

[AQUARIUS]

Σ **2781.** XXI^h 10^m, S 8° 9′ : 7·8, 7·8 : 172°·1 : 3″·3 : wh.

Σ **2928.** XXII^h 33^m S 13° 14′ : 8, 8 : 327°·7 : 4·7 : wh. (Bin. ?)

Σ **2825.** XXI^h 40^m, N 0° 17′ : 8, 8·2 : 100°·2 : 1″·1 : yelsh. (Fl bin.)

Σ **2851.** XXI^h 55^m, S 12° 35′ : 8, 8·3 : 120°·8 : 19″·1 : o, o.

Σ **2817.** XXI^h 36^m, S 0° 8′ : 8·2, 8·5 : 156°·3 : 25″·9 : wh. [In a fine field.]

Σ **2970.** XXII^h 56^m, S 11° 59′ : 8·5, 9 : 35°·3 : 8″·4 : o, o. [Pretty field.]

Σ **2981.** XXIII^h 3^m, S 9° 29′ : 8·8, 8·8 : 112°·4 : 3″·6 : o, o. (6^m 22^s *p*, 15 *n*, from ψ^1.)

Σ **2887.** XXII^h 11^m, S 1° 19′ : 9, 9 : 25°·7 : 8″·8 : o, o.

[τ^2. XXII^h 43^m, S 14° 13′ : beautiful or. 5 m^g. star, with distant companion, H 10 m^g. ; Fr 9 m^g. lilac or blsh.]

(ω^2. XXIII^h 37^m, S 15° 12′ : 5, 12 : est. 90° : 3″ : very beautiful ; test for 4½ or 5 in. achr. Bu.)

35, 6 m^g. is guide to pair *nf*, XXII^h 3^m, S 19° 4′ : 8·5, 8·5 : est. 75° : 2″. Bu.

60, 6 m^g., 1½° *s* of η, XXII^h 29^m, S 0° 44′, guides to pair 13′ *s* : 8·5, 9·5 : est. 210° : 2″, with 13 m^g. *comes s p*. Bu.

Vars.—R. XXIII^h 38^m, S 15° 57′ : 5·8, 8·5—11 ? 388^d ? Increase quicker than decrease. Red.

S. XXII^h 51^m, S 20° 59′ : 7·7, 9·1—below 11·5 : 279^d ?

T. XX^h 44^m, S 5° 35′ : 6·7, 7—12·4, 12·7 : 203^d ?

Nebulæ and Groups.

4678 (M 2). XXI^h 27^m, S 1° 22′. Beautiful large round neb. diam. 5′ or 6′, showing with 3$\frac{7}{10}$ in. a granulated aspect.

[AQUARIUS]

the precursor of resolution. H compares it to a heap of fine sand, and considers it to be composed of thousands of 15 m^s. stars. Sm observes that 'this magnificent ball of stars condenses to the centre and presents so fine a spherical form, that imagination cannot but picture the inconceivable brilliance of their visible heavens, to its animated myriads.'

4628 (H IV 1). xx^h 58^m, S 11° 50′. Planetary; somewhat elliptic; very bright for an object of this nature; pale bl.; not well defined in 5½ f. achr., but bearing magnifying more like a planet than a common nebula. One of the finest specimens of these extraordinary bodies, to which their discoverer H assigned a distinct class. E. of Rosse finds a very thin ray on each side, which I saw with Huggins's 15 in. achr. La detects within it a bright well-defined elliptic ring: Bufffham, 9 in. spec., an opening. Se, who made its diameters 25″ and 17″, saw it sparkle, and thought it a heap of stars: the spectroscope however of Huggins reveals the astounding fact that it is a mass of incandescent gas. About 1⅓° *p ν*, 5 m^s.

[Fine field, *lucida* 7 m^s. ±[1] $xxiii^h$ 28^m, S 10° 40′.]

[Very curious symmetrical group, ± $xxiii^h$ 10^m, S 5° 10′.]

AQUILA.

Al Tair (xix^h 45^m, N 8° 33′), the *lucida* of this rich constellation, has been thought var., and has a very sensible prop. mot. All the Galaxy here is strewed with pairs and groups of stars.

Double Stars.

γ. xix^h 41^m, N 10° 19′ : 3 : very fine yel. Not inserted for Sm's 12 m^s. attendant, but for its beautiful field with a

[1] This symbol indicates that the places, obtained by a very rough mounting, are mere approximations.

[AQUILA]

curious doubly-curved row of stars a little *s*. 3′ *s* Bu points out a pair 10 or 11 m^{s}. : est. 10° : 3″ : a 3rd star 20″ *p*, all seen by Wa with $4\frac{3}{10}$ in. achr. It is now brighter than *β*, which may imply a change in one of the stars; though in many instances Bayer, who affixed the Greek letters in 1603, seems not to have been entirely influenced by magnitude. *β*, according to OΣ, is carrying with it through space a very minute companion discovered by Lamont, 11–12 m^{s}. 12″ distant; annual progress nearly 0″·5, orbital motion uncertain.—*δ* (with several delicate *comites*) is in a beautiful neighbourhood.

π (Σ **2583** : 6, 6·8). XIX^{h} 43^{m}, N 11° 31′ : 6, 7 : 121°·3 : 1″·7, 1836 (K 1″·5, 1865) : pale wh., grnsh., 1831, 1836. Σ yelsh., 1829; so Fr 1879; Se yel., bl., 1855; De both wh., 1856. [Not single, 80, very close 144; good test. $5\frac{1}{2}$ in. showed a 14 m^{s}. star *n p*, Sa indigo. Common sees 3 others *n p* with $18\frac{1}{4}$ in. spec.]

15. XVIII^{h} 59^{m}, S 4° 13′ : 6, 7·5 : 206°·6 : 34″·5 : wh. or yelsh. wh., red lilac. 1° nearly *n* from λ Antin.

23 (Σ **2492** : 5·5, 9·5). XIX^{h} 12^{m}, N 0° 52′ : 6, 10 : 12°·6 : 3″·1 : light or., grey. $\frac{H}{O}$ and Sm found 10 increasingly visible with higher powers, which struck me independently : not perceived with 80, it was distinctly seen with 144. An elegant object, but requiring fine weather; easily found from *δ* and *ν*.

28. XIX^{h} 14^{m}, N 12° 10′ : 6, 10 : 175°·7, 1831 (Fr est. 180°, 1876) : 59″·8 : pale wh., deep bl.

57 (Σ **2594** : 5·2, 6·2). XIX^{h} 48^{m}, S 8° 32′ : 6·5, 7 : 171°·5 : 35″·4 : bl., 1834; Σ v. wh., 1835; [distinctly contrasted, 1851; pale yel., pale lilac, 'cols. entirely different,' 1855; a totally independent observation, as I had not identified the object; pale yel., blsh. or grnsh., certainly unlike,

[AQUILA]

9 in. spec. 1871; Whitley bright wh., redsh. wh., 1868; K wh., v. pale bl., 1871; so Sa 1875; Fr yelsh. wh., blsh. or lilac, 1876. This pair should be watched, as two of the first observers have attested the similarity of the colours.]

5 (Σ **2379** : 5·6, 7·4). Triple. XVIII^h 40^m, S 1° 5′ : 7, 8, 1838 (Se 5, 5, 1855), 14 : 121°·5, 145° : 13″·3, 30″ : wh., lilac, bl. 14 is so minute, Sm says, as to have escaped former observers except ♅. I have on several occasions, 1850 to 1852, seen it more or less distinctly by averted vision, though 14 m^g. was usually far beyond my reach : it rather improves with magnifying : very minute, 9 in. spec. 1871. 5 is η Serp. of some maps.

11 (Σ **2424** : 5·7, 9·2). XVIII^h 54^m, N 13° 28′ : 7, 10 : 240°·9 : 19″·1 : pale wh., smalt bl. Sm thought 7 might have been rated 6; so Fl and Sa; De and Heis 5. Equilateral with ε and ζ. [A pretty 10 m^g. pair f a little n : another about 38′ s; 14′ f is Σ **2426**, 6·8, 8·2 : 79°·8 : 16″·9 : redsh. yel., grey. Bird, Gl and others reverse angle; Fr as Σ, 1876. 10, 6 m^g. closely n p 11, stands between 2 curious groups.]

P XX 2 (Σ **2634**: 8, 9·5). XX^h 4^m, N 16° 27′[1] : 7, 10: 13°·2 : 5″·9 : pale topaz, lucid bl. ♅ red, deeper red; but he was partial to red tints. I thought 7 wh., 1850; so Fr 1876.

P XIX 144 (Σ **2532** : 6, 10·2). XIX^h 24^m, N 2° 39′ : 7, 11, 1838 : 4°·9 : 37″ : deep yel., pale grn. [11 readily visible 1850, 1855, even considerably out of focus, and several hours past meridian, as if 10 m^g.; the colour also, previously known, was evident; K 11–12, 1871. 1° f δ, furthest of two f that star. A pretty pair, very unequal, n p.]

P XIX 307 (Σ **2590** : 7·1, 10). XIX^h 47^m, N 10° 3′ :

[1] The declination is somewhat uncertain, but that here given *will suffice* for bringing the object into a moderate-sized field.

[AQUILA]

7, 13 : 307°·8 ; 15″ : lucid wh. [so 1864 ; pale or. 1865 ; Sa v. wh., 1874, as Σ 1830], bl. Light-test for moderate apertures. Sa 12 m^g. 1875. Said to have been seen with 3 in. achr. Minute pair *p*, a little *s*. Just *f o*, 5 m^g. 1½° *n* of *α*.

P XVIII 302 (Σ **2446** : 6·3, 8·3). XIX^h 0^m, N 6° 22′ : 7·5, 9 : 153°·9 : 10″·3 : lucid wh., cerul. bl. Brightest in the vicinity. [Beautiful triple, nearly in line, 8, 10, 14, 9 3/10 spec. 1873. 14 unnoticed by Σ var ?]

P XIX 241 (Σ **2562** : 6·5, 8·2). XIX^h 37^m, N 8° 6′ : 7·5, 9·5, 1833 : 253°·7 : 26″·8 : pale topaz, lilac. [9·5 larger ? 1850 ; P rated it 10 ; Fr as Sm, 1876. Several minute points near, 9 in. spec. Equilateral with *α* and *γ*. 1° *p* lies a pretty pair, 9·5, 11 : and again, not far *s p*, a very fine field.]

P XIX 257 (Σ **2570** : 7·3, 9·5). XIX^h 39^m, N 10° 29′ : 8, 10 : 276°·5 : 4″ : wh., smalt bl. A. G. Clark 8 double, exceedingly close. Just *n p γ*. A pretty group a little *n*.

P XX 43, 44. XX^h 8^m, N 6° 13′ : 8·5, 8·5 (1833) : 11°·7 : 43″·6 : lucid wh. [*s* star the smaller, 1850, reverse of Sm : wh., bl., 1871] ; K both wh., *s* the less, 1871. Fr angle reversed 1876.—Sa coarse pair *s f*.

P XVIII 263 (Σ **2428** : 8, 9·8). XVIII^h 54^m, N 14° 45′ : 8·5, 10·5 : 289°·1 : 6″·5 : pale yel., 1836 [wh., 1850], sapph. bl. 'Handsome test-object,' Sm. [10·5 occasionally distinct, though long past meridian, 1850 ; 12 m^g. 1871. 10′ *s* very little *f ε*, 3 m^g., a beautiful yel. star. A fine field.]

P XIX 250 (Σ **2567** : 7·7, 9·5, 1829). XIX^h 38^m, N 12° 5′ : 8·5, 14, 1838 : 312° : 20″ : wh., bl.—14 var ? K 10·2, 1862 ; Fr 10, 1876 ; [much larger than 10 of P XIX 257, 1865.]

[AQUILA]

Σ **40**[1] * (24, P XIX 55). XIX^h 13^m, N 0° 10′ : 6, 6·2 : 136°·1 : 423″·1 : wh., yel.

Σ **2628**. XX^h 2^m, N 9° 3′ : 6·1, 8·2 : 349° : 4″·5 : yelsh. wh., purp.

Σ **45**[1]. XIX^h 37^m, S 8° 34′ : 6·5, 6·9 : 146°·7 : 96″·6 : wh.

Σ **2587**. XIX^h 45^m, N 3° 46′ : 6·5, 9·2 : 98°·6 : 4″·1 : gold, o.

Σ **2489**. XIX^h 11^m, N 14° 20′ : 6·5, 9·5 : 349°·3 : 8″·2 : wh., o. (Fr bl.) [Very delicate.]

Σ **2447**. XIX^h 0^m, S 1° 31′ : 6·7, 9·1 : 345° : 13″·8 : yelsh.

Σ **2597**. XIX^h 49^m, S 7° 4′ : 6·9, 8 : 92°·1 : 1″·9 : wh.

Σ **2497**. XIX^h 14^m, N 5° 20′ : 6·9, 8 : 358° : 30″ : yelsh., wh. [A fine object.]

Bu **142**. XIX^h 22^m, S 12° 23′ : 7, 7 : est. 145° : 1″·4.

Σ **2613**. XIX^h 56^m, N 10° 24′ : 7, 7·2 : 350°·7 : 4″·7 : yelsh. wh.

Σ **2646**. XX^h 8^m, S 6° 24′ : 7, 8·8 : 51°·6 : 24″·7 : wh. o.

Σ **2449**. XIX^h 1^m, N 6° 57′ : 7·1, 7·8 : 292°·3 : 8″ : wh.

Σ **2498**. XIX^h 14^m, N 3° 48′ : 7·2, 7·8 : 66°·7 : 12″·2 : yel., purpsh.

Σ **2596**. XIX^h 48^m, N 14° 57′ : 7·2, 8·6 : 353° : 2″·1 : yelsh., ash. (Bin ?)

Σ **2436**. XVIII^h 56^m, N 8° 35′ : 7·4, 8·1 : 309° : 34″·6 : yelsh. wh., blsh. wh.

Σ **2679**. XX^h 19^m, N 19° 11′ : 7·4, 8·7 : 79°·8 : 21″·9 : wh., o.

OΣ **370** (P XIX 49). XIX^h 11^m, N 9° 7′ : 7·5, 8·2 : 14°·6 : 19″·6 : redsh., blsh.

Σ **2408**. XVIII^h 46^m, N 10° 38′ : 7·5, 8·7 : 96°·6 : 2″·3 : wh., ash.

Σ **2621**. XIX^h 59^m, N 8° 53′ : 7·7, 7·9 : 222° : 5″·7 : wh.

* This small numeral is a reference to Struve's Appendix I.

[AQUILA]

Σ **2437.** XVIII^h 57^m, N 19° 0′ : 7·8, 8 : 80°·8 : 1″·1 : wh. (Bin.)

Σ **2612.** XIX^h 56^m, N 6° 36′ : 7·8, 8·8 : 52°·8 : 36″·6 : wh.

Σ **2651.** XX^h 8^m, N 15° 47′ : 8, 8 : 279°·9 : 1″·6 : wh.

Σ **2443.** XVIII^h 59^m, N 14° 37′ : 8·2, 8·6 : 312°·8 : 6″·3 : wh.

Σ **2513.** XIX^h 19^m, N 2° 11′ : 8·2, 8·8 : 313° : 2″·2 : yelsh. wh.

Σ **2399.** XVIII^h 43^m, N 13° 7′ : 8·2, 8·8 : 119°·6 : 15″·7 : o, o. [Quadruple.]

Σ **2636.** XX^h 5^m, S 4° 56′ : 8·2, 9·2 : 201°·8′ : 12″·5 : o, o.

Σ **2670.** XX^h 16^m, N 16° 0′ : 8·3, 8·7 : 151°·3′ : 30″·6 : yel., wh.—Triple ; 10·7 : 77°·7 : 16″·5.

Σ **2412.** XVIII^h 47^m, N 13° 52′ : 8·4, 8·5 : 53°·3 : 1″·3 : yelsh.

Σ **2510.** XIX^h 18^m, N 9° 17′ : 8·5, 8·5 : 181°·7 : 8″·7 : v. wh. [Very pretty.]

Σ **2618.** XIX^h 58^m, N 15° 8′ : 8·6, 8·9 : 115°·5 : 5″·3 : wh.

(ζ. XIX^h 0^m, N 13° 41′, 3 m^s. has *comes* 11 m^s. (Σ's scale) est. 60° : 5″. Bu 26 in. achr. Has been seen with 9$\frac{6}{10}$ in. achr.) [A curious stream of stars *n p*.]

(ε. XVIII^h 54^m, N 14° 54′, 3·5 m^s. is closely followed by a triplet. Wa.)

[69. XX^h 23^m, S 3° 17′, 5 m^s. has a pretty triangle *s p*, one of which is 68, 7 m^s.]

[About $\frac{1}{3}$ from ζ Aquil. towards α and β Sagittæ are two 6 m^s. naked-eye stars (Bode 67, 71) near together. The *n p* is a fine wide pair, 6, 8 : yel., pale lilac. The other is Σ **2489**, *ante*.]

[Pair ± XX^h 28^m, N 1° 0′ : 7, 9 or 10 : wide : or., bl. *s* in a triangle.]

[Curious line of 4 stars 8 m^s., ± XIX^h 20^m, N 12° 12′.]

[AQUILA]

[Pair ± xx^h 16^m, N 12° 33′ : 8·5, 8·5 : est. 150° : 25″. Beautiful.]

[Pair ± xx^h $6·5^m$, N 9° 48′ : 9, 10 : pale ruby, bl. very pretty.]

[Pair in pretty field, ± xix^h 38^m, N 0° 50′.]

[Red Stars.]—B 483. $xviii^h$ 58^m, S 5° 52 : 7·5.—A star 5 m^g. ± 7^m *p*, 5′ *n*, yel. points at 20′ *s p* to a star 8 m^g., fine bl.

B 464. $xviii^h$ 43^m, S 8° 2′ : 9.

B 475. $xviii^h$ 52^m, N 14° 12′ : 9.

Vars. — R. xix^h 1^m, N 8° 3′ : 6·4, 7·4—10·9, 11·2 : 345^d. Unsteady. Red.

S. xx^h 6^m, N 15° 16′ : 8·9, 9·9—10·7, 11·8 : 147^d. Unsteady. Reddish.

T. $xviii^h$ 40^m, N 8° 37′ : 8·8, 9·5 : Irreg. H plum-col^d.

Cluster.

4451 (H 2024). $xviii^h$ 44^m, N 10° 10′. [Interesting field.]

ARGO NAVIS.

Not in itself a remarkable constellation, but in a crowded part of the Galaxy.

Double Stars.

P VII 149, 147. vii^h 29^m, S 23° 13′ : 6, 6 : 284°·1 : 10″·2 : topaz. [*n p* rather larger, 1851, 1856; reverse of Sm 1831; so Se 1856 (who gives red, bl.), Gore 1875.]

P VIII 72, 74. $viii^h$ 20^m, S 23° 39′ : 6, 9·5 : 85°·4 : 45″ : or., blsh. grn.

P VII 175, 177. vii^h 34^m, S 26° 32′ : 6·5, 6·5 : 326°·8 : 9″·8 : topaz yel. [Both much larger, 1851, than P VII

[ARGO NAVIS]

149, 147, as if m^gs. accidentally reversed. Jacob 5·5, 5·5, 1846; so Main, 1863; Se 6, 6·5, 1856; Fr both 5 or 5·5, 1877.]

2 (Σ **1138** : 6·2, 7). VII^h 40^m, S 14° 24′ : 7, 7·5 : 338°·8 : 16″·8 : silvery wh., pale wh. In field with 4, 5 m^g. pale yel.

[About 1° 20′ *s*, a wide 7 m^g. pair, deep or., has a bin. aspect; 5½ in. 1864. K 6·4, 6·4 : 310°·7 : 128″.]

5 (Σ **1146** : 5·3, 7·4, 1831). VII^h 42^m, S 11° 54′ : 7·5 [6 **A**, Heis, Gould), 9 : 19° : 3″·5 : pale yel., light bl. 1834. (9 ruddy ? 1851; so Fr 1877, and m^gs. more as Σ.]

Bu **208**. VIII^h 33^m, S 22° 16′ : 6, 9 : 30° : 1″·4 : 'exquisite.'

Σ **1104**. VII^h 24^m, S 14° 45′ : 6·7, 8·3 : 292°·4 : 2″·3 : wh. (Fl bin. and c. p. m.)

Σ **1121**. VII^h 31^m, S 14° 14′ : 7·2, 7·5 : 304°·7 : 7″·5 : wh.

Bu **201**. VII^h 34^m, S 20° 0′ : 8, 8 : est. 330° : 2″–4″.

Bu **334**. VIII^h 2^m, S 21° 42′ : 8, 9 : est. : 350° : 12″.

Σ **1178**. VII^h 58^m, S 12° 52′ : 9, 9 : 330°·1 : 4″·8 : 0, 0.

Σ **1101**. VII^h 23^m, S 13° 35′ : 9, 9 : 89°·3 : 6″·2 : 0, 0.

(**11**. VII^h 52^m, S 22° 34′, guides to beautiful triangle. B.)

Red Stars.—B Add. II, 6. VII^h 28^m, S 14° 16′ : 6.

B Suppl. H3973. VII^h 27^m, S 20° 41′ : 10 (smallest of pair, 'remarkable brick red,' H).

Clusters and Nebula.

1551 (H VIII 38). VII^h 31^m, S 14° 12′. Grand broad group, visible to naked eye, too large even for 64 : some brilliant 5 or 6 m^g. stars, including Σ **1121**, which see *supra*. About 2½° *f* is a group round 4, 5 m^g. A fiery 5 m^g. (B 7 m^g.) leads the region.

[ARGO NAVIS]

1564 (M 46). VII^h 36^m, S 14° 32′. Beautiful circular cloud of small stars (H 10 m^g.), about ½° in diam.: best with low power: a little *p* the group round 4, nearer to it than 1551. 1565, a feeble neb. on its N. verge, is in La's 20 f. refl. 'an astonishing and interesting object;' he and E. of Rosse see it annular: so Buffham, 9 in 'With.' Not gaseous.

1571 (M 93). VII^h 39, S 23° 34′. Bright cl. in a rich neighbourhood. H 8–13 m^g.

1630 (H VII 11). VIII^h 5^m, S 12° 34′. Large loose cl. of stars, chiefly about 10 m^g., closely *n p* 19 Arg., a 6 m^g. yel. [bright or.] star, attended by a fine group. 19 seems larger than 6 m^g. to my unaided eye.

1611 (H VI 37). VII^h 54^m, S 10° 27′. Fine broad starry cloud, from 10 m^g. down to mere nebulosity; much better with 64 than higher powers. Vicinity gorgeous.

1567 (H IV 64). VII^h 37^m, S 17° 55′. Plan. neb. bright; pale blsh. wh.; H 12″ or 15″. With my 64, like a dull 8 m^g. star: with more power, small, brilliant, undefined, surrounded with a little very faint haziness. In a glorious neighbourhood. E. of Rosse a red star 9–10 m^g. *f.* I find no spectroscopic result.

ARIES.

Three stars near together mark it to the naked eye, but it reaches some way further E. into a dull region.

Double Stars.

γ (Σ 180: 4·2, 4·4). 1^h 47^m, N 18° 42′: 4·5, 5: 359°·8, 1837 (Mitchel 175°·6, 1847): 8″·8: bright wh., *pale grey* or faint bl.; some disagreement as to cols. Dis-

covered by Hooke in following the comet of 1664. 'I took notice that it consisted of two small stars very near together; a like instance to which I have not else met with in all the heaven.' Good object for small telescopes.

ϵ (Σ **333** : 5·7, 6). $11^h\ 52^m$, N 20° 52′ : 5, 6·5 : 193°·5 : 0″·5, 1835 (K 198°·4 : 1″, 1866; Hall 201°·9 : 1″·3, 1876) : pale yel., whsh. Buffham, 4½ in. 'With' mirror, 1869. Σ vars? Bin?

π (Σ **311** : 4·9, 8·4). Triple. $11^h\ 43^m$, N 16° 58′ : 5, 8·5, 11 : 121°·6; 109°·9 : 3″·1, 25″ : pale yel., flushed, dusky. H 11 brighter than 8·5, 1782. 2 largest moving. [*Comites* not seen, 1855; 9·5, 13, 9 in. 1871; so Sa 1874; Fr 11 more like 13 or 14, 1876.]

λ. $1^h\ 51^m$, N 23° 1′ : 5·5, 8 : 45°·6 : 36″·9 : yelsh. wh., bl., 1830; Whitley 8 redsh. lilac, 1863. Pointed at by γ and β.

14. Triple. $11^h\ 3^m$, N 25° 22′ : 5·5, 10·5, 9 : 43°·5, 278°·6 : 82″·6, 106″·5 : wh., bl., lilac [very fine col.]. B sees another *comes*, smaller and more distant; Sa adds a 4th est. 16 : 80° : 90″.

30, P II 128 (Σ 5 App. I : 6·1, 7·1). $11^h\ 30^m$, N 24° 8′ : 6, 7 : 273° : 38″·3 : topaz yel., pale grey; (Main equal, 1863; Sa not 1 m^s. diff. 1874; Fr not more than 0·5 m^s. 1876: Main both wh., 1863; Whitley both grey, 1868.) 'The most southern of a group of about a dozen double stars, spread over the adjoining portions of the three constellations, Aries, Musca, and Triang. with extensive patches of dark and blank space between them.' Sm.

1, P I 179 (Σ **174**: 6·2, 7·4). $1^h\ 44^m$, N 21° 41′ : 6, 8 : 169°·9 : 2″·4 : topaz yel., smalt bl., 1836. De wh., 1854. 80 just divides this beautiful pair. 2° *n p* β.

33 (Σ **289** : 5·8, 8·7. $11^h\ 34^m$, N 26° 33′ : 6, 9 : 0°·2 :

[ARIES]

28″·5 : pale topaz, light bl. [9 seems very small.] In Musca.

P I 222. Quadruple. 1h 53m, N 20° 28′ : 6, 15, 10, 9 : 53°, 165°, 359°·2 : 2″·5, 40″, 165″ : topaz yel., deep bl., lilac, pale bl. exquisite but most difficult; admirable test. [Not examined.]

52 (Σ **346** : 6, 6). Quadruple. 11h 58m, N 24° 47′ : 6·5, 7, 15, 13, 1835 (K 11, 12·5, 1865) : 265°·7, 1835 (K 268°·9, 1866), 355°, 85° : 0″·8, 5″, 105″ : bright wh., pale bl., bl., lilac. 'Most difficult.' [6·5 notched, 450 of $5\frac{1}{2}$ in. 1861.] Wa 15 easy, $4\frac{3}{10}$ in. achr. 6·5 and 7 probably moving.

10 (Σ **208** : 6·2, 8·4). 1h 57m, N 25° 22′ : 6·5, 8·5 : 26°·8 : 2″·2, 1838 (De 33°·9 : 1″·4, 1863 ; Do 41°·1 : 1″·3 ; 1877) : yel., pale grey. Bin.—B triplet in field *s f.*—Between *a* Ariet, and *a* Tri. nearest former.

Σ **305**. 11h 41m, N 18° 52′ : 7·3, 8·2 : 330°·9 : 1″·6 : yel. (Gl moving).

Σ **291**. 11h 34m, N 18° 17′ : 7·4, 7·7 : 119° : 3″·3 : wh.

Σ **224**. 11h 4m, N 13° 7′ : 7·5, 8 : 242°·4 : 5″ : yelsh. wh., wh.

Σ **240**. 11h 10m, N 23° 17′ : 7·7, 8·2 : 48° : 4″·7 : wh. (Gl change ?)

Σ **273**. 11h 25m, N 17° 50m : 7·7, 8·7 : 358°·3 : 6″·9 : wh.

Σ **178** (P I 191). 1h 45m, N 10° 13′ : 7·8, 7·8 : 193°·3 : 3″·1 : wh.

Σ **376**. 111h 14m, N 19° 19′ : 7·9, 8 : 251°·2 : 6″·8 : v. wh.

Σ **300**. 11h 38m, N 28° 56′ : 7·9, 8·1 : 300° : 2″·9 : v. wh. (Gl bin. ?)

Σ **194**. 1h 52m, N 24° 15′ : 8, 8·3 : 264°·1 : 1″·2 : yelsh. wh.

Σ **212**. 1h 59m, N 24° 30′ : 8, 8·5 : 165°·9 : 2″ : wh.

[ARIES]

Σ **175.** 1^h 44^m, N 20° 31′ : 8·2, 8·5 : 327°·9 : 10″·4 : v. wh.

Σ **338.** 11^h 55^m, N 10° 21′ : 8·2, 8·5 : 200°·3 : 20″·1 : wh.

Σ **342.** 11^h 58^m, N 27° 27′ : 8·3, 8·8 : 306°·6 : 3″·1 : wh.

Σ **237.** 11^h 9^m, N 10° 14′ : 8·4, 8·7 : 238°·5 : 14″·6 : wh.

Σ **200.** 1^h 55^m, N 23° 29′ : 8·5, 9 : 124°·2 : 8″ : v. wh.

Σ **261.** 11^h 18^m, N 10° 58′ : 8·6, 8·7 : 249°·2 : 3″ : yelsh. wh.

Σ **244.** 11^h 11^m, N 21° 38′ : 8·8, 9 : 289°·8 : 4″·4 : wh.

Vars.—R. 11^h 9^m, N 24° 30′ : 7·6, 8·5—11·9, 12·7, 186^d.
—6 m^g. star *p*.
S. 1^h 58^m, N 11° 57′ : 9·1, 9·8—below 13 : 288^d ?
T. 11^h 42^m, N 17° 2′ : 7·9, 8·2—9·4, 9·7 : 324^d.

AURIGA.

The leader of this beautiful constellation, Capella (v^h 8^m, N 45° 52′), is very brilliant. H and Σ think it has increased. H classed it decidedly above Wega in 1847, otherwise than he had formerly, and therefore second in the heavens. So Galle and Heis. With me, Wega takes precedence; but the objects are distant, and differ in colour, wh. and sapphire, and, as Sm observes, this difference may influence estimates of size. Ptolemy, El Fergani (10th cent.), and Riccioli, have all called Capella *red*. Its parallax as deduced by O Σ shows amazing distance, far exceeding that of some smaller stars, and requiring nearly 11 y. for the transmission of its light to us. (Peters, however, presses 70 y.)

Double Stars.

14 (Σ **653** : 5, 7·2). v^h 8^m, N 32° 33′ : 5, 7·5 : 224°·5 : 1″·5 : pale yel., or., 1832; grnsh. yel., blsh. yel., 1850;

[AURIGA]

Σ pale grn., blsh. wh., 1830 [pale yel., lilac, 1850; so Fr 1877]. Σ triple; 11 : 342°·4 : 12″·6, 1830. [Pretty steady, 9⅓ in. spec.] Glimpsed by Miss Mitchel, 5 in. achr. 1861 : Du moving, 1872.

26 (Σ **753** : 5·8, 8). v^h 31^m, N 30° 25′ : 5, 8 : 267°·8 : 12″·3 : dusky wh. (D and De yel.), pale bl. 3° *n f β* Tauri. Morton triple, 14 m^s. est. 114° : 24″ [*staring*, 9⅓ in. spec.] Du 4th fainter.

ω (Σ **616** : 4, 7·9). IV^h 51^m, N 37° 43′ : 5, 9 : 352°·6 : 7″ : flushed wh., light bl., 1831, 1833, 1850; Σ pale grn., blsh. wh., 1828 [wh., ruddy, 1850; an unusual combination, plainer with 80 than 250; so Fr 1877]. 4, A, Proctor.

56. VI^h 38^m, N 43° 42′ : 6, 8·5 : 17°·1 : 56″·8 : 1831 (De 22°·1 : 47″·8, 1877) : silvery wh., lilac.

41 (Σ **845** : 5·2, 6·4). VI^h 2^m, N 48° 44′ : 7, 7·5 : 352°·8 : 8″·2 : silvery wh., pale viol. Relatively fixed, c. p. m., a not infrequent phænomenon.

P V 225 (Σ **796** : 6·9, 8). v^h 42^m, N 31° 45′ : 8, 8·5 : 61°·5 : 3″·8 : creamy wh., pale grey.

OΣ **545** (θ). v^h 52^m, N 37° 12′ : 3, 7·5 : 5°·6 : 2″·1. (2 very minute *comites*.)

OΣ **103** (16). v^h 10^m, N 33° 14′ : 5·2, 11 : 56°·6 : 4″·5 : yel., o. (Wa glimpsed with $4\frac{3}{10}$ in. achr.) Es pair *f*, 7·5 or 8, 9 : est. 190° : 10″ : v. yel., v. bl.—9 has *comes* 13 or 14 m^s. 2″. Fine test.

Σ **872**. VI^h 7^m, N 36° 12′ : 6, 7 : 217°·4 : 11″ : wh. 1828. [pale yel., pale lilac, 1872; so Fr 1877; De wh., 1868.]

OΣ **152** (54). VI^h 32^m, N 28° 22′ : 6, 7·8 : 40°·2 : 0″·9 : yelsh., grn.

OΣ **92** (5). IV^h 52^m, N 39° 13′ : 6, 9·7 : 230°·1 : 2″·8 : *yelsh., o* (Bin ?). Seen by Bird and Hunt.

[AURIGA]

Σ **698.** v^h 17^m, N 34° 45′ : 6·2, 7·7 : 346°·2 : 31″·1 : yel., blsh. [Beautiful.]

Σ **645.** v^h 2^m, N 27° 52′ : 6·2, 8·2 : 26°·8 : 11″·7 : wh., ash.

Σ **764.** v^h 34^m, N 29° 27′ : 6·3, 6·8 : 13°·8 : 25″·9 : v. wh. (2^m 48^s *f*, 1° *s*, from 26.) [1]

Σ **572.** IV^h 31^m, N 26° 41′ : 6·5, 6·5 (vars.) : 210°·3 : 3″·2 : yelsh., 1830. (Fr 7 or 7·5, 1877.)—(Slow bin.)

Σ **644.** v^h 2^m, N 37° 9′ : 6·7, 7 : 219°·2 : 1″·6 : gold, blsh. red; remarkable and constant cols. Gl moving. *p* is a cl. 996 (H VIII 61.)

Σ **918.** VI^h 24^m, N 52° 33′ : 6·7, 7·7 : 322°·4 : 4″·4 : wh. (Bin.)

Σ **623.** IV^h 52^m, N 27° 10′ : 6·8, 8·3 : 205°·1 : 20″·4 : v. wh., wh.

Σ **941.** VI^h 30^m, N 41° 41′ : 7, 8 : 77°·6 : 1″·9 . blsh. wh., purpsh. wh. (Fl fine red and bl.—Slow bin.) [*n* star of 2 in finder, 1° *s* of 50 Aur., $5m^g$.]

Σ **945.** VI^h 32^m, N 41° 6′ : 7·1, 8 : 249° : 1″·1 : wh. (Bin.)

Σ **929.** VI^h 27^m, N 37° 48′ : 7·1, 8·2 : 24°·6 : 6″ : yelsh., v. bl. (Es nearly in field with Σ **928** *infra*. Between, a beautiful triangle, 6·5 yelsh., 8·5, 9, v. bl.—*np* is B 148, or. red. 6·3.)

Σ **718.** v^h 23^m, N 49° 17′ : 7·2, 7·2 : 74°·2 : 7″·8 : v. wh.

Σ **994.** VI^h 51^m, N 37° 16′ : 7·2, 7·5 : 56°·8 : 25″·6 : v. wh.

Σ **799.** v^h 44^m, N 38° 31′ : 7·2, 8·3 : 192°·5 : 1″·1 : wh.

Σ **736.** v^h 29^m, N 41° 44′ : 7·2, 8·5 : 342°·4 : 2″. wh., blsh. (3^m 8^s *f*, 1° 38′ *n* from χ.—Fl bin. ?)

[1] Nearly all these comparative positions are from Es.

[AURIGA]

Σ **699.** v^h 17^m, N 37° 56′ : 7·3, 8 : 342°·9 : 8″·8 : v. wh.

Σ **928.** vi^h 27^m, N 38° 38′ : 7·4, 8 : 134°·4 : 3″·4 : yelsh. wh., wh. (Es yel. grnsh.)

Σ **648.** v^h 3^m, N 31° 51′ : 7·4, 8·1 : 74°·3 : 4″·7 : yelsh., blsh.

Σ **657.** v^h 9^m, N 52° 43′ : 7·5, 8 : 273°·9 : 1″·4 : wh.

Σ **888.** vi^h 13^m, N 28° 31′ : 7·5, 9·2 : 246°·2 : 2″·7 : v. wh., ash. ($\pm 4^m$ *f*, 56′ *s*, from κ.)

Σ **577.** iv^h 34^m, N 37° 16′ : 7·7, 7·7 : 278°·7 : 1″·6 : wh. (Slow bin.)

Σ **805.** v^h 44^m, N 28° 25′ : 7·7, 8·4 : 48°·4 : 12″·1 . wh.

Σ **613.** iv^h 50^m, N 43° 56′ : 7·7, 8·7 : 106°·6 : 19″·8 : wh.—Triple ; 11·7 : 18°·8 : 15″·8.

Σ **778.** v^h 37^m, N 30° 52′ : 7·7, 9 : 185°·8 : 3″·2 : yelsh. wh., o.

Σ **669.** v^h 10^m, N 45° 7′ : 7·8, 8·3 : 275°·5 : 9″·7 : v. wh. (2^m 22^s *f*, 46′ *s*, from *a*).

Σ **825.** v^b 54^m, N 36° 30′ : 7·8, 9 : 146°·2 : 8″·2 : wh. (1^m 59^s *f*, 41′ *s*, from θ.)

Σ **802.** v^h 44^m, N 40° 8′ : 7·9, 8·5 : 108°·7 : 3″·2 : v. wh. (53^m *f*, 1° 1′ *n*, from ν.)

Σ **666.** v^h 9^m, N 33° 11′ : 8, 8 : 71°·3 : 3″ : v. wh. (1^m 4^s *p*, 3′ *s*, from 16 ; a small triplet *nf* 16.)

Σ **603.** iv^h 45^m, N 49° 24′ : 8, 8·2 : 238°·6 : 8″·4 : v. wh.

Σ **933.** vi^h 28^m, N 41° 13′ : 8, 8·5 : 74°·7 : 25″·6: v. wh.

Σ **979.** vi^h 48^m, N 46° 42′ : 8, 8·8 : 209°·7 : 7″·4 : v. wh.—Bird 8·8 down to 9·5, v. bl.

Σ **834.** v^h 57^m, N 30° 15′ : 8, 8·8 : 307°·9 : 22″·9 : wh.

Σ **861.** vi^h 4^m, N 30° 46′ : 8·2, 8·2 : 318°·2 : 1″·6 : wh.—Triple ; 7·8 wh. (Gl moving.) ($\pm$ 1^m 38^s *p*, 1° 13′ *n*, from κ.)

[AURIGA]

Σ **737.** v^h 29^m, N 34° 2′ : 8·2, 8·5 : 305° : 10″·7 : wh.

Σ **883.** vi^h 11^m, N 39° 49′ : 8·2, 8·7 : 263°·4 : 3″·3 : o, o.—Triple; 10·4 : 257°·8 : 28″·7.

Σ **1012.** vi^h 58^m, N 28° 20′ : 8·2, 8·7 : 167°·4 : 12″·7 : o; o.

Σ **687.** v^h 14^m, N 33° 40′ : 8·2, 9 : 67°·6 : 17″·2 : o, o.—Triple; 9·2 : 153°·5 : 48″·7. (Es pale or., 2 bl.)—Bird miniature of Orion's belt, with little triangle *s*.

Σ **706.** v^h 19^m, N 30° 14′ : 8·2, 9·3 : 36°·8 : 3″·7 : wh.

Σ **896.** vi^h 16^m, N 51° 55′ : 8·3, 8·7 : 82°·3 : 20″ : wh.

Σ **964.** vi^h 42^m, N 43° 54′ : 8·3, 9 : 195°·5 : 1″·7 : wh.

Σ **906.** vi^h 21^m, 37° 29′ : 8·3, 9·5 : 335°·9 : 6″·6 : wh., o.

Σ **884.** vi^h 12^m, N 47° 9′ : 8·5, 8·5 : 270° : 9″ : v. wh.

Σ **808.** v^h 45^m, N 29° 44′ : 8·5, 8·5 : 57°·4 : 16″ : o, o.

Σ **619.** iv^h 52^m, N 50° 6′ : 8·7, 8·7 : 106° : 5″·4 : wh. (Slow bin.)

Σ **791.** v^h 42^m, N 39° 32′ : 8·7, 9·3 : 90°·2 : 4″·9 : wh.

Σ **621.** iv^h 52^m, N 39° 2′ : 9, 9 : 131°·4 : 9″·8 : o, o.

Red (orange) Star.—B 148, vi^h 28^m, N 38° 32′ : 6·3.—A little *f* is Σ **940** : 8, 10 : 293°·2 : 10″·1 : wh., o; a little *p* is Σ **928**, *ante*.

Vars. ε. iv^h 53^m, N 43° 39′ : 3—4·5 : irregular.

R. v^h 8^m, N 53° 27′ : 6·5, 7·4—12·5, 12·7.

Clusters, Nebula, and Groups.

1119 (M 38). v^h 21^m, N 35° 47′. Noble cl. arranged as oblique cross; pair of larger stars in each arm; brighter star in centre; [not brighter than pairs, 1871. Larger stars dot it prettily with open doubles. Glorious neighbourhood.]

[AURIGA]

1166 (M 36). v^h 28^m, N 34° 4′. Beautiful assemblage of stars, 8—14 m^s., very regularly arranged. $2°\,f\,\phi$.

1295 (M 37). v^h 44^m, N 32° 32′. Sm calls this 'a magnificent object: the whole field being strewed, as it were, with sparkling gold-dust; and the group is resolvable into about 500 stars, from 10 to 14 m^s., besides the outliers.' Even in smaller instruments extremely beautiful, one of the finest of its class. Gaze at it well and long. K notices a brighter star near centre. All the stars in this mass must be nearly at the same distance from us, and consequently their real sizes must be different. The aspect of the Nubecula Major in the S. hemisphere convinced H of this: it is ocular proof of the incontrovertible though long discredited fact that the apparent brightness of stars has very little connection with their distance from the Earth. (*See* App. I.)

[1137 (H I 261). v^h 24^m, N 34° 9′. Haze surrounding 4 minute stars, $9\frac{1}{3}$ in. spec.—H 3 only in 3 obs. E. of Rosse and d'A, 5.]

1067 (H VII 33). v^h 12^m, N 39° 13′. Splendid region.

(H V 22. Fine field, including λ, v^h 11^m, N 39° 59′: $5m^s$. Wa.)

[17, 18, 19. $\pm$ v^h 10^m, N $33\frac{3}{4}°$. Grand large field.]

BOÖTES.

A fine constellation, of which the leader, Arcturus (XIV^h 10^m, N 19° 49′), is placed next to Sirius, and before Wega, by H and H; Seidel gives Wega precedence. Fletcher has rated it alternately above and below Capella. A noble object at all times, but never so interesting as when, enveloped in the tail of Donati's comet, 1858, Oct. 5, and *only 20′* from the nucleus, it flashed out so vividly its su-

periority. Sm calls it reddish yel.; it is golden yel. to me: Schm thought it had of late years lost all redness, and was growing paler. The first star seen in daytime, by Morin, 1635: it is stated, however, that Galileo saw stars by day. Schm has seen it *with the naked eye* 24 m. before sunset![1] Arcturus has a great annual proper motion of more than 1″ RA, and nearly 2″ Dec.: so that, as Humboldt says, it has moved 2½ times the Moon's diam. since the days of Hipparchus. Yet its parallax is almost insensible; so that, according to Peters, we wait for its light more than 25 y. How inconceivable, then, must be its dimensions and its speed! Besides this motion, Huggins finds with the spectroscope attached to his 15 in. achr. that it is approaching us at the rate of 55 miles per second! Boötes is rich in pairs, poor in clusters and nebulæ.

Double Stars.

ε (Σ 1877: 3, 6·3). XIV^h 40^m, N 27° 35′: 3, 7: 321°·2: 2″·9, 1838 (K 324°: 2″·7, 1867; Do 324°·7: 3″, 1877): pale or., sea-grn. Se 'most beautiful yel., superb bl.' This 'lovely object,' as Sm calls it, is probably bin. of long period; a well-known test for moderate telescopes. Buffham has split it with 1⅞ in. of 9 in. 'With' spec. I have seen it perfectly with 2¼ in. achr. 80 of 3$\frac{7}{10}$ in. divided it.

ζ (Σ 1865: 3·5, 3·9). XIV^h 35^m, N 14° 15′: 3·5, 4·5: 307°·3, 1″·2, 1842 (Do 299°·8: 1″, 1877): bright wh., blsh. wh. Σ alternately var:; so Se. Probably bin. Excellent

[1] Stone, with the 12¾ in. Greenwich object-glass, finds its heating power perceptible, and considerably greater than that of Wega, which, however, can be detected. Huggins gives its heat equal to that of Regulus, and ½ greater than that of Sirius; Castor showing none.

test: elong., or in contact, $3\frac{7}{10}$ in. 144, 250, 1854; wide, $9\frac{1}{3}$ in. spec. 450, 1869.

π (Σ **1864**: 4·9, 6). XIV^h 35^m, N 16° 56′: 3·5, 6: 99°·3, 1836 (Do 101°, 1877): 6″: wh., 1836; wh., creamy, 1850: several observers see a slight difference. Bin. ?

ξ (Σ **1888**: 4·7, 6·6). XIV^h 46^m, N 19° 36′: 3·5, 6·5: 332°·1: 7″·3, 1831 (De 299°: 5″·3, 1866; Do 282°·9: 4″, 1877): deep yel., flushed purp. 1857 (De yel., or., 1856.) Bin.; H 117 y. Hind, 169 y. Do 127 y.—Bu beautiful pair, 1^m *f*, 23′ *s*: 8, 10: 187°·8: 1″·3. Discovered by A. Clark, jun.

δ (Σ 27 App. I: 3·2, 7·4). XV^h 11^m, N 33° 46′: 3·5, 8·5: 75°: 110″: yel., lilac. B among pairs and triplets.

μ^1 (Σ 28 App. I). XV^h 20^m, N 37° 47′: 4, 8: 171°·8: 109″: yelsh., grnsh. wh. Whitley, 8 lilac. Companion, μ^2 (Σ **1938**: 6·7, 7·3): 8, 8·5: very close; 321°·4: 1″·3, 1832; Σ 327°: 1″·4, 1826; D 190°·1: 0″·5, 1865; K est. 150°: 0″·5, 1872; Do 129°·4: 0″·7, 1878. Bin., period doubtful between 315 and 183 y. Probably all one system, as Σ finds c. p. m.

ι (Σ 26 App. I: 4·9, 7·5). XIV^h 12^m, N 51° 55′: 4·5, 8: 33°·4: 37″·9: light yel., dusky wh., 1838; D 8 deep purp. 1848. Σ thought c. p. m. and believed 4·5 to be oblong. Wa minute *comes s.*

44 (Σ **1909**: 5·2, 6·1). XV^h 0^m, N 48° 7′: 5, 6: 233°·8: 2″·9, 1830 (Fletcher 240°·1: 4″·6, 1865; Do 238°: 5″, 1877): pale wh., lucid grey, 1842; yel., cerul. bl., 1850; Σ pale wh., pale bl., 1832; Fletcher wh., yel., 1851; Miller wh., 1853; De yel., or., 1856; [yel., ruddy or purpsh. 1850]. Σ and A have found var. light here. Widening. Certainly bin.; but period uncertain; Do 261 y.

39 (Σ **1890**: 5·8, 6·5). XIV^h 46^m, N 49° 13′: 5·5, 6·5,

[BOÖTES]

1839; scarcely diff. 1847 : 44°·7 : 3″·8 : wh., lilac [scarcely 1 m^s. diff. 1850; not more than 0·5 m^s., 1876]. Se 6, 6·5, 1856; 6, 6·2, 1857. A little *n p* 44.

κ (Σ **1821** : 5·1, 7·2). XIV^h 9^m, N 52° 21′ : 5·5, 8, 1838 (De 4, 6, 1855) : 238°·1 : 12″·7 : pale wh., blsh.

P XIV 69 (Σ **1835** : 5·5, 6·8). XIV^h 18^m, N 9° 0′ : 6, 7·5, 1835 (De 4·8, 6·8, 1853, 1855; Du 4·5, 6·5, 1869; P 8·9 for 7·5) : 186°·2 : 6″·3 : flushed wh., smalt bl., 1835. De golden yel., rose tint, 1853, 1855. [6 pale yel.; 7·5 sometimes bl., more usually tawny, 1854; 9 in. spec. 1872 : an uncertainty of hue, which I have found troublesome in the smaller components of some pairs.]

1 (Σ **1772** : 6·2, 9·1). XIII^h 35^m, N 20° 34′ : 6, 10 : 147°·1 : 4″·9 : sapph. bl., smalt bl. P XIII 161, 7m^s. blsh.; and Fl another bl., in field.

P XIV 279 (Σ **1910** : 7, 7). XV^h 2^m, N 9° 41′ : 7·5, 7·5 : 209°·7 : 4″, 1835 (Gl 212°·7 : 4″·2, 1874) : pale wh. Slow bin.?

P XIII 220, 219. XIII^h 45^m, N 21° 52′ : 7·5, 8 : 208°·5 : 85″·8 : flushed wh., 1831. [Some diff. in col., 1852; 9 in. spec. 1872, yelsh., blsh. wh.? but very little in mag., each about 7; 220 rather the larger. Fr slight diff. 1876. 6, a fine yel. 5 m^s. star in field.]

OΣ **270** (*τ*). XIII^h 41^m, N 18° 3′ : 4·8, 11·4 (*see* App. I) : 347°·8 : 10″·3 : grnsh wh., o. 11·4 var.? Wa $4\frac{3}{10}$ in. achr. Sa easy $6\frac{1}{2}$ in. spec., and fine lilac. Fl c. p. m.

Σ **1850**. XIV^h 23^m, N 28° 49′ : 6·1, 6·7 : 262°·2 : 25″·7 : v. wh., 1833. [pale yel., pale bl., 9 in. spec. 1872; so Fr 1876.]

Σ **1919**. XV^h 7^m, N 19° 44′ : 6·1, 7 : 10°·2 : 24″·8 : yelsh. wh., wh.

Σ **1926**. XV^h 10^m, N 38° 43′ : 6·1, 8·4 : 260°·6 : 1″·6 : yelsh., bl.

[BOÖTES]

Σ **1884.** XIV^h 43^m, N 24° 52′: 6·2, 7·8 : 52°·2 : 1″·2 : yelsh., blsh., 1829. (D wh., brownish, 1848.)

Σ **1825.** XIV^h 11^m, N 20° 41′: 6·8, 8·5 : 185°·7 : 3″·4 : wh., o, 1830. (Fr 8·5 ruddy or dusky, 1876. Do 174°·7 : 4″, 1877. Fl slow bin.). *f a*, 1° *n*.

Σ **1883.** XIV^h 43^m, N 6° 28′ : 7, 7 : 272° : 1″·2 : yelsh., 1830. [Not equal, 1872.] (Fl slow bin. Bird a solitary object.)

Σ **1871.** XIV^h 38^m, N 51° 55′ : 7, 7 : 283°·2 : 1″·8 : wh. (Bin.)

Σ **1816.** XIV^h 9^m, N 29° 40′ : 7, 7·1 : 80°·2 : 1″·9 : yelsh.

Σ **1921.** XV^h 7^m, N 39° 5′ : 7, 7·2 : 283°·7 : 30″·3 : wh.

Σ **1793.** XIII^h 54^m, N 26° 23′ : 7, 8 : 242°·3 : 4″·4 : wh., blsh.

Σ **1916.** XV^h 5^m, N 39° 28′ : 7, 9·5 : 329°·6 : 10″ : yelsh. wh., o.

Σ **1834.** XIV^h 16^m, N 49° 3′ : 7·1, 7·2 : 113°·7 : 1″·4 : o, o, 1851. (Gl 0″·6, 1871. Closing. Severe test.)

Σ **1838.** XIV^h 18^m, N 11° 47′ : 7·2, 7·3 : 334°·4 : 8″·9 : wh.

Σ **1785.** XIII^h 44^m, N 27° 35′ : 7·2, 7·5 : 164°·4 : 3″·5 : wh., 1830. (K v. pale yel., blsh., 1871; so Fr 1876. Do 208°·4 : 2″·2, 1877. Bin. c. p. m.)

Σ **1858.** XIV^h 29^m, N 36° 5′ : 7·2, 8 : 35°·2 : 2″·2 : wh.

Σ **1843.** XIV^h 20^m, N 48° 23′ : 7·2, 8·7 : 188°·1 : 20″·1 : wh., o.

Σ **1886.** XIV^h 45^m, N 10° 11′ : 7·2, 9·2 : 228°·2 : 7″·5 : yelsh. wh., o.

Σ **1867.** XIV^h 36^m, N 31° 48′ : 7·7, 8·2 : 21°·8 : 1″·6 : wh. (Fl bin.)

Σ **1829.** XIV^h 11^m, N 51° 1′ : 7·7, 8·2 : 150°·3 : 5″·3 : wh.

Σ **1874.** XIV^h 38^m, N 49° 38′ : 7·7, 9·2 : 288°·4 : 25″·7 : *yelsh., o.*

[BOÖTES]

Σ 1873. XIV^h 39^m, N 8° 13′ : 7·8, 8·3 : 94°·4 : 6″·3 : v. wh., 1828. [yelsh., blsh., 1871.]

Σ 1895. XIV^h 53^m, N 40° 39′ : 7·8, 8·3 : 43°·4 : 12″·4 : v. wh.

Σ 1813. XIV^h 7^m, N 6° 0′ : 8, 8·1 : 191° : 4″·8 : wh. (Bin. ?)

Σ 1817. XIV^h 9^m, N 27° 17′ : 8, 8·6 : 7° : 1″·6 : wh.

Σ 1808. XIV^h 5^m, N 27° 11′ : 8, 9 : 68°·8 : 2″·8 : wh. (Bin. ?)

Σ 1804. XIV^h 3^m, N 21° 46′ : 8, 9 : 18°·3 : 4″·4 : wh., bl. (Fl bin. ?)

Σ 1797. XIII^h 56^m, N 20° 0′ : 8·2, 8·5 : 160° : 21″·1 : wh.

Σ 1855. XIV^h 27^m, N 32° 11′ : 8·2, 9·1 : 248°·6 : 15″·3 : wh.

Σ 1908. XV^h 0^m, N 34° 56′ : 8·2, 9·2 : 137°·2 : 1″·5 : wh., o.

Σ 1826. XIV^h 11^m, 47° 33′ : 8·2, 9·2 : 315°·1 : 4″·4 : wh., o.

Σ 1839. XIV^h 17^m, N 54° 26′ : 8·3, 8·3 : 261°·9 : 14″·4 : v. wh.

Σ 1810. XIV^h 6^m, N 28° 36′ : 8·4, 9 : 173°·8 : 1″·8 : wh.

Σ 1934. XV^h 13^m, N 44° 16′ : 8·5, 8·5 : 45°·1 : 5″·3 : wh. (Bin. ?)

Σ 1920. XV^h 7^m, N 47° 22′ : 8·5, 8·5 : 291°·1 : 19″ : yelsh. wh.

Σ 1907. XV^h 0^m, N 12° 4′ : 8·5, 8·7 : 11°·8 : 1″·1 : o, o.

Σ 1794. XIII^h 54^m, N 20° 27 : 8·5, 8·7 : 129°·8 : 2″ : yelsh.

Σ 1814. XIV^h 7^m, N 50° 49′ : 8·5, 9 : 256°·2 : 11″. wh.

Σ 1923. XV^h 8^m, N 14° 51′ : 8·5, 9·2 : 12°·5 : 4″·8 : yel., o.

[BOÖTES]

Σ 1875. XIV^h 39^m, N 38° 16′ : 8·7, 9·2 : 310°·7 : 3″·2 : wh.

Σ 1861. XIV^h 31^m, N 12° 41′ : 8·7, 9·2 : 175°·5 : 14″ : o, o.

Σ 1917. XV^h 7^m, 15° 49′ : 9, 9·3 : 239°·3 : 2″·2 : o, o.

Σ 1828. XIV^h 11^m, N 24° 43′ : 9·2, 9·2 : 160°·1 : 1″·9 : o, o.

(θ. XIV^h 21^m, N 52° 24′ : 4 m^g. has 12m^g. *comes* est. 170° : 60″. Wa.)

Red Stars.—P XV 156 (closely *n f* P XV 153—XV^h 35^m, N 47° 12′) 6·5 m^g., fine red. Fr 1878.

[B 328. XIV^h 19^m, N 26° 15′ : 8 var. ?]

Vars.—R. XIV^h 32^m, N 27° 16′ : 5·9, 7·5—11·3, 12·2 : 223^d.

S. XIV^h 19^m, N 54° 21′ : 8·1, 8·5—13·2 : 272^d.

T. XIV^h 8^m, N 19° 38′ : 9·7 ?—invis. Seen but once.

Nebula.

[4029 (H II 756). XIV^h 56^m N 54° 23′. Faint : guide to 7·5 m^g. pair *f*, from which a straight line of smaller stars extends.]

CAMELOPARDUS.

Wide-spread, but obscure ; containing many good objects.

Double Stars.

2 (Σ 566 : 5·1, 7·4). IV^h 30^m, N 53° 15′ : 5·5, 7·5 : 308°·7, 1836 ; De 299°·5, 1863 : 1″·7 : yel., pale bl. ; 'an exquisite object' [not seen]. Bin. c. p. m. Pair in field, De 8·5, 9·5 : 264°·2 : 5″·7.

P IV 269 (Σ 634 : 4·5, 7·9). V^h 3^m, N 79° 5′ : 5·5, 9 : 349°·1 : 33″·8 : light yel., pale bl. Moving opposite ways.

[CAMELOPARDUS]

P XII 232, 230 (Σ **1694** : 4·9, 5·4). XII^h 48^m, N 84° 4′ : 6, 6·5, 1832 (Main equal, 1862) : 327°·3 : 21″·8 : bright wh., 1833 ; so Σ 1832, Main 1862. [Some diff. 1852, $3\frac{7}{10}$ in. : pale yel. ? pale viol. ? not quite a match, 1863, $5\frac{1}{2}$ in.] Fr pale yel., lilac, 1877.—Sm *comes* 11 m^s. *s p.*

35. V^h 54^m, N 51° 34′ : 7, 10 : 14°·4 : 30″ (39 ?) : wh., lilac.

1 (Σ **550** : 5·1, 6·2). IV^h 23^m, N 53° 39′ : 7·5, 8·5 : 307°·9 : 10″·4 : wh., sapph., 1838 ; so D ; De grn. or bl., pale rose, 1854. Nearly half-way from *α* Pers. to *δ* Aur., a little *n* of line ; in an ill-marked, but rich and beautiful district.

P VII 159, 160 (Σ **1122** : 7·1, 7·1). VII^h 34^m, N 65° 27′ : 8, 8 : 4°·7 : 15″·6 : wh., 1839 ; Fr decidedly yelsh., 1877.

7 (Σ **610** : 4·2, 11·3). IV^h 48^m, N 53° 33′ : 5, 13 : 239°·2 : 27″ : wh., or. (Bu easy, 6 in. achr. 1871 ; Wa $4\frac{3}{10}$ in. achr., 1873). De added, 1864, a companion, 7·9 : 308°·8 : 1″·2 : olive. He had never seen so 'sombre' a star. [Not examined.]

Σ **385.** III^h 19^m, N 59° 31′ : 4·7, 9 : 161°·4 : 2″·4 : yel., o.

Σ **390.** III^h 21^m, N 55° 2′ : 4·8, 9·2 : 159°·6 : 15″ : grnsh. wh., o. [Pale ruby 7·5 m^s. *s f.*]

Σ **13**^{1} (11, 12). IV^h 55^m, N 58° 49′ : 5, 6 : 7°·1 : 181″·3 : blsh., v. yel. or red. [yelsh. wh., pale red. Fine field.]

OΣ **67.** III^h 47^m, N 60° 45′ : 5, 8·2 : 39°·3 : 1″·7 : gold., grn.

Σ **1193.** VIII^h 7^m, N 72° 46′ : 6, 9 : 85°·2 : 44″·4 : v. yel., o.

Σ **485.** III^h 57^m, N 62° 2′ : 6·1, 6·2 : 303°·3 : 18″ : wh., blsh. wh.—In field with **484.** 9, 9·5 : 132°·4 : 5″·4 : o, o.—Triple ; 9 : 324°·3 : 22″·6.

Σ **1127.** VII^h 36^m, N 64° 21′ : 6·2, 8 : 340°·4 : 5″·2 : v. wh., ashy.—Triple ; 9·2 : 174°·9 : 11″·3.

[CAMELOPARDUS]

Σ 396. III^h 24^m, N 58° 21′ : 6·3, 8 : 241°·8 : 20″·4 : wh. (Fr wh., bl. 1877.)

Σ 1625. XII^h 11^m, N 80° 47′ : 6·5, 7 : 218°·8 : 14″·3 : v. wh. (Sometimes in other constell.)

Σ 973. VI^h 48^m, N 75° 24′ : 6·6, 7·6 : 26°·7 : 11″·9 : wh.

Σ 3115. V^h 37^m, N 62° 45′ : 6·7, 7·8 : 35°·6 : 1″·7 : wh., ashy wh. (Fl bin.)

Σ 780. V^h 39^m, N 65° 43′ : 6·7, 7·9 : 103°·6 : 3″·8 : yel., bl.—Triple; 10·2 : 154°·9 : 10″·9.

Σ 618. IV^h 52^m, N 62° 54′ : 7, 7·3 : 211°·5 : 32″·2 : wh.

Σ 400. III^h 25^m, N 59° 38′ : 7, 8 : 282°·6 : 1″·5 : yelsh. wh., blsh. wh., 1829. (Gl 295° : 1″·2, 1873. Bin.?)

Σ 389. III^h 21^m, N 58° 57′ : 7, 8 : 61°·8 : 2″·8 : wh., purpsh., 1831. (Fr greatly under-rated, conspicuous to eye, 1877. Fl bin.?)

Σ 1006. VI^h 56^m, N 62° 46′ : 7, 8 : 71°·6 : 30″·6 : yelsh., wh.

Σ 374. III^h 13^m, N 67° 2′ : 7, 8·5 : 294°·7 : 10″·8 : wh., ash.

Σ 587. IV^h 39^m, N 52° 55′ : 7, 8·5 : 185° : 20″·9 : wh., blsh.

OΣ 54. III^h 20^m, N 67° 10′ : 7·2, 8·5 : 354°·5 : 25″·8.

Σ 349. III^h 1^m, N 63° 21′ : 7·4, 8·1 : 319°·8 : 6″·1 : wh.

Σ 638. V^h 1^m, N 69° 43′ : 7·5, 8·5 : 222°·4 : 5″·3 : yelsh., v. bl.

Σ 1169. VII^h 58^m, N 79° 51′ : 7·6, 7·9 : 10° : 20″·7 : yelsh. wh., wh.

Σ 677. V^h 13^m, N 63° 16′ : 7·7, 8 : 279°·4 : 1″·7 : v. wh. (Fl slow bin.)

Σ 362. III^h 7^m, N 59° 35′ : 7·7, 8 : 142°·3 : 6″·9 : v. wh. (D quintuple. In beautiful wh. group.)

Σ 384. III^h 19^m, N 59° 29′ : 7·8, 9 : 267°·5 : 2″ : gold, bl.

[CAMELOPARDUS]

Σ 553. IV^h 24^m, N 50° 49′ : 8, 8·5 : 133°·3 : 3″·1 : wh.

Σ 335. II^h 55^m, N 63° 18′ : 8, 8·5 : 158°·5 : 24″·4 : wh.

Σ 557. IV^h 26^m, N 62° 44′ : 8, 8·7 : 126°·1 : 23″·4 : wh.

Σ 283. II^h 31^m, N 60° 58′ : 8, 8·8 : 209°·2 : 1″·8 : yel., ashy.

Σ 1479. X^h 50^m, N 83° 52′ : 8, 9 : 21°·9 : 4″·6 : yelsh. wh., ashy wh.

Σ 1539. XI^h 21^m, N 81° 41′ : 8, 9·2 : 313°·1 : 19″ : yelsh. wh., wh.

Σ 604. IV^h 47^m, N 69° 54′ : 8·1, 8·9 : 39°·9 : 2″·2 : wh.

Σ 526. IV^h 15^m, N 59° 59′ : 8·2, 8·7 : 52°·2 : 5″·7 : wh.

Σ 455. III^h 45^m, N 69° 10′ : 8·2, 8·7 : 167°·4 : 11″·9 : o, o.

Σ 445. III^h 41^m, N 59° 45′ : 8·2, 9·2 : 253°·2 : 3″ : wh.

Σ 282. II^h 31^m, N 65° 8′ : 8·3, 8·3 : 294° : 7″ : wh.

Σ 480. III^h 55^m, N 55° 24′ : 8·3, 8·5 : 324°·2 : 3″·2 : yelsh.

Σ 695. V^h 23^m, N 79° 15′ : 8·3, 9 : 155°·8 : 10″·3 : o, o.—Triple; 9 and 9·7 : 172°·5 : 1″·9.

Σ 1720. XII^h 59^m, N 83° 35′ : 8·4 , 8·7 : 334°·6 : 1″·6 : r. wh.

Σ 522. IV^h 13^m, N 51° 20′ : 8·5, 8·5 : 37°·8 : 1″·5 : o, o.

Σ 368. III^h 10^m, N 68° 3′ : 8·5, 8·5 : 342°·1 : 2″·3 : wh.

Σ 474. III^h 57^m, N 75° 55′ : 8·5, 8·5 : 145°·4 : 22″·6 : wh.

Σ 617. IV^h 52^m, N 62° 51′ : 8·5, 8·7 : 120°·6 : 12″·4 : wh.

Σ 868. VI^h 9^m, N 73° 58′ : 8·5, 9 : 41°·8 : 3″·3 : wh.

Σ 490. IV^h 0^m, N 59° 50′ : 8·5, 9 : 55°·7 : 4″·6 : wh.

Σ 784. V^h 49^m, N 84° 12′ : 8·7, 8·7 : 187°·7 : 1″·3 : yelsh. wh.

Σ 831. V^h 58^m, N 67° 58′ : 8·7, 8·7 : 74°·1 : 11″·8 : o, o.

Σ 386. III^h 19^m, N 54° 44′ : 8·8, 8·8 : 58°·8 : 2″·5 : wh.

Σ 503. IV^h 6^m, N 63° 52′ : 8·8, 8·8 : 226°·7 : 4″·3 : wh.

[CAMELOPARDUS]

Σ 1471. x^h 43^m, N 80° 26′ : 9, 9·1 : 3″·6 : 2″·1 : wh.

β. IV^h 53^m, N 60° 16′ : 4·5 m^s., fine wide pair with P IV 242. H VI 36.—Fr lucid yel., fine bl.

[P III 97. III^h 33^m, N 59° 35′ : 6, 9; K 34°·3 : 55″·6 : or. with scarlet glare, bl.]

Red Stars.—B 51. II^h 47^m, N 63° 50′ : 6·5 var.?

B 65. III^h 32^m, N 62° 15′ : 6·6.

B 83. IV^h 39^m, N 67° 57′ : 7.

H 2244. IV^h 52^m, N 69° 12′ : 9, 9 : both remarkably red, H.

Var.—R. XIV^h 27^m, N 84° 23′ : 7·9, 8·6—12? 266^d, irreg.

Nebulæ.

801 (H IV 53). III^h 57^m, N 60° 31′. Plan. : small and dim. E. of Rosse sees it a bright ring, with star 14 m^s. in central darkness. Closely *f*, 1½° *n*, is H VII 47, an elegant group with 7 m^s. pair, preceded by a wider one.

(1691 (H I 288). $VIII^h$ 40^m, N 78° 40′. Nucleus like 11 m^s. star.)

CANCER.

A constellation marked only to the naked eye by the remarkable cluster Præsepe.

Double Stars.

σ^2* (Σ 1291 : 5·9, 6·4). $VIII^h$ 47^m, N 31° 2′ : 5·5, 7 : 335° : 1″·4 : wh., yel. [Good test : elongated $3\frac{7}{10}$ in. 80; divided, 144.] ι^2 of F, H, H, South, Σ, who finds diff. of mag.

* There is much confusion as to 4 different stars marked σ in this constellation, arising probably, as Fr has shown, from a mistake of A's as to the two streams of stars in which they occur. On this account F's nos. 64 and 66 have been substituted for σ^2 and σ^4 in the following list.

[CANCER]

var. Bird, 'One of the loveliest pairs,' both crocus yel. with very minute *comes*.

ι (Σ **1268** : 4·4, 6·5). VIII^h 39^m, N 29° 12′ : 5·5, 8, 1836 (De 4, 6·5 vars. 1858) : 307°·8 : 30″ : pale or., clear bl. Beautiful contrast. Σ **1266** in field *s p*; 8, 9·2 : 63°·5 : 23″·5 : wh., o.

ζ (Σ **1196** : 5, 5·7). Triple. VIII^h 5^m, N 18° 1′ : 6, 7, 7·5 : 28°·3, 149°·4 : 1″·3, 5″·4, 1832 ; 322°·7, 144°·1 : 0″·9, 4″·8, 1853 (De 134°·4 : 5″·6, 1870) ; D 6, 7 : 243°·4 : 0″·6, 1865 [well separated, 8 in. 'With' spec. power 300, 1865] ; K 166°·9 : est. 0″·6 ; Key, 18 in. spec. est. 0″·55, 1872 (periastron) ; De 108°·7 : 0″·7, 1877 [1 disc apart, 9$\frac{1}{3}$ in. spec. 1878] : yel., or., yelsh., 1832–1843 ; De all wh., 1854–5–6 ; 7·5 yelsh. or olive, 1864–5. Bin. ; close pair revolving in not much less than 100 (Jacob, 110) y. OΣ, however, gives 62 ; Plummer 58 y. ;—companion in very remarkable orbit of 600 or 700 y. C. p. m. Excellent test ; pointed at by α and β Gem : at double distance.

ϕ^2 (Σ **1223** : 6, 6·5, 1826). VIII^h 20^m, N 27° 20′ : 6, 6·5, 1833, 1843 : 213°·9 : 4″·8 : wh., pale wh., 1849. De yel., 1854 ; [much less unequal, 1849 ; nearly equal, 1856 ; so Talmage 1865 ; Fr 1877 ; Du ± 0·1 m^s. diff. 1871, 1874 ; still more striking if compared with υ^1 ; $\frac{1}{4}$ or $\frac{1}{3}$ m. diff. 9 in. spec. 1872.] De 6·5, 6·5, 1854.

66 (Σ **1298** : 6·1, 8·2). VIII^h 54^m, N 32° 43′ : 6, 9 : 136°·4 : 4″·8 : lucid wh., sky-bl.

υ^1 (Σ **1224** : 6, 7·1). VIII^h 20^m, N 24° 56′ : 7, 7·5 : 40°·1 : 5″·8 : creamy wh., pale bl. ; this col. var. ? Σ 1·1 m^s. diff. 1830 ; De almost as much, 1855 ; Du ± 0·5 m^s. 1869, 1874 [considerably unequal, 1849]. Fl bin. and c. p. m.

[CANCER]

Σ **1177.** VII^h 58^m, N 27° 52′ : 6·5, 7·4 : 354°·7 : 3″·5 : v. wh., ashy wh. D pale grn., pale yel.

Σ **1254** (P VIII 129). VIII^h 34^m, N 20° 4′ : 6·5, 9 : 53°·9 : 20″·5 : v. yel., o.

Σ **1311.** IX^h 1^m, N 23° 28′ : 6·7, 7.1, 1831 (Du 0·1 diff. 1869, 1872) : 200°·5 : 7″·2 : wh. [A little *n p* ξ, 5 m^g.]

Σ **1283.** VIII^h 43^m, N 15° 17′ : 7, 8 : 123°·3 : 16″·5 : wh.

OΣ **186.** VII^h 56^m, N 26° 34′ : 7·5, 8·2 : 74°·1 : 0″·8 : wh.

Σ **1322.** IX^h 6^m, N 17° 0′ : 7·7, 8·2 : 52° : 1″·7 : v. wh. (Bird above 2 wide pairs.)

Σ **1276.** VIII^h 41^m, N 11° 36′ : 7·9, 8·1 : 354°·3 : 12″·5 : wh.

Σ **1228.** VIII^h 21^m, N 27° 56′ : 8, 8·5 : 352° : 8″·9 : v. wh. [Not far from line from ϕ^1 to ϕ^2, nearer ϕ^1.]

Σ **1188.** VIII^h 2^m, N 30° 44′ : 8, 8·7 : 201°·3 : 15″·9 : v. wh.

Σ **1327.** IX^h 8^m, N 28° 25′ : 8, 9·2 : 81°·4 : 16″·1 : o, o, 1831 (Bu 77°·8 : 13″·5, 1878.).—Triple; 9 : 27°·9 : 25″·1.

Σ **1231.** VIII^h 23^m, N 31° 46′ : 8·2, 8·7 : 210°·6 : 24″·8 : v. wh.

Σ **1197.** VIII^h 5^m, N 29° 55′ : 8·2, 9 : 102°·6 : 1″·6 : wh.

Σ **1297.** VIII^h 53^m, N 23° 11′ : 8·2, 9·3 : 162°·2 : 4″·7 : wh.; o. (6^m 47^s *p*, 16′ *s*, from Σ **1311** *supra.*)

Σ **1170.** VII^h 53^m, N 14° 1′ : 8·3, 8·3 : 95°·7 : 2″·2 : wh.

Σ **1246.** VIII^h 30^m, N 10° 19′ : 8·4, 9·4 : 114°·1 : 10″·3 : yelsh., o. [A pretty pair.]

Σ **1219.** VIII^h 16^m, N 8° 1′ : 8·5, 8·5 : 260° : 11″·6 : wh.

Σ **1179.** VII^h 58^m, N 12° 25′ : 8·5, 8·5 : 205°·2 : 17″·9 : o, o. (Bu wider, and triple; 12 : 59°·8 : 3″·8.)

[CANCER]

Σ **1301.** VIII^h 55^m, N 26° 41′ : 8·5, 9 : 0°·2 : 10″ : o, o.

Σ **1300.** VIII^h 55^m, N 15° 45′ : 8·7, 8·8 : 210° : 4″·1 : yel. (Moving.—3^m 46^s *f*, 18′ *s*, from o^2.)

Σ **1191.** VIII^h 4^m, N 19° 25′ : 8·7, 9·2 : 70°·9 : 3″·2 : wh.

Σ **1288.** VIII^h 46^m, N 28° 54′ : 8·9, 9 : 259°·2 : 7″·4 : o, o.

Σ **1206.** VIII^h 9^m, N 7° 32′ : 9, 9·5 : 199° : 13″·2 : o, o.

6. Triple. VII^h 56^m, N 28° 8′ : 5, 13, 14 : est. 70°, 180° : 70″, 65″. B.

64. VIII^h 51^m, N 32° 55′ : 5·6, 8·9 : 294°·8 : 89″·7. South, 1823.

67. VIII^h 54^m, N 28° 23′ : 6, 8 : 322°·7 : 103″·1. South, 1823.

Red Star.—B 211. VIII^h 49^m, N 17° 41′ : 6·5.

Vars.—R. VIII^h 10^m, N 12° 6′ : 6·2, 8·3—below 11·7 : 354^d. Incr. quicker than decr.

S. VIII^h 37^m, N 19° 28′ : 8·2—9·8 : 9^d 11^h 37^m. Decr. quicker than incr.

T. VIII^h 50^m, N 20° 19′ : 8·2, 8·5—9·3, 10·5 : 484^d. Red.

U. VIII^h 29^m, N 19° 18′ : 8·2, 10·4—below 13 : 305^d.

V. VIII^h 15^m, N 17° 40′ : 6·8, 7·2—below 12 : 272^d.

Clusters.

1681 (M 44). VIII^h 33^m, N 20° 22′. The Præsepe of the ancients, just resolved by the naked eye; too large for usual fields, but full of fine combinations: two triangles will be noted. Galileo counted 36 stars in it, with his newly-constructed telescope.

1712 (M 67). VIII^h 45^m, N 12° 15′. Cl. (H about 200 stars, 10—15 m^s.) Visible in finder.

CANES VENATICI.

The nebulæ here are fine. The only prominent star comes first on the list.

Double Stars.

12 (Σ **1692** : 3·2, 5·7. Cor Caroli). XII^h 50^m, N 38° 58′ : 2·5, 6·5 : 227° : 19″·8 : flushed wh., pale lilac, 1837; full wh., v. pale, 1850; pale reddish wh., lilac, 1855; Σ wh., 1830; H 'with all attention I could perceive no contrast of cols.,' 1830–1; De wh., pale olive bl., 1856; K very pale yel., pale lilac, 1865; Grover creamy, fine bl., 1867; Fr bright wh., fawn-col., 1879. [wh. or yelsh., tawny or lilac, 1850, $3\frac{7}{10}$ in.; ditto, little contrast, $5\frac{1}{2}$ in., 1862; pale yel., fawn-col. 1865; pale yel., pale copper, 9 in. spec., 1870.] Relatively fixed for 73 y., yet considerable c. p. m.: unequal stars at nearly equal distances from us.

2 (Σ **1622** : 5·7, 8). XII^h 10^m, N 41° 20′ : 6, 9 : 259°·5 : 11″·3 : gold. yel., smalt bl. [Striking, though not conspicuous; $\frac{1}{3}$ from Cor Caroli towards δ Leon.]

Σ **24**^{1} (15, 17). XIII^h 4^m, N 39° 8′ : 5·5, 5·9 : 297°·5 : 290″ : yelsh., wh.

Σ **1768** (25). XIII^h 32^m, N 36° 54′ : 5·7, 7·6 : 76° : 1″·1 : 1831 (single, De 1831, Du 1869, 1875; Schi 0″·4, 1876) : wh., bl.

Σ **1615**. XII^h 8^m, N 33° 28′ : 6, 8·2 : 88°·3 : 26″·9 : yelsh., ashy.

Σ **1606**. XII^h 5^m, N 40° 33′ : 6·3, 7 : 348°·6 : 1″·4 : wh. (Bin. ?)

OΣ **261**. XIII^h 6^m, N 32° 44′ : 6·9, 7·4 : 353° : 1″·1 : *yelsh.* Widening.

[CANES VENATICI]

Σ **1645.** Closely *f* **1642** *infra* : 7, 7·5 : 161°·5 : 10″·4 : yelsh. wh. (Bird 'a lovely pair as I ever saw.')

Σ **1755.** XIII^{h} 27^{m}, N 37° 24′ : 7, 7·9 : 133°·8 : 4″·3 : yelsh. wh., blsh. (Bird 7·9 grnsh. yel.)

OΣ **257.** XII^{h} 51^{m}, N 46° 15′ : 7·5, 8·2 : 353°·6 : 13″·1.

OΣ **263.** XIII^{h} 12^{m}, N 51° 13′ : 7·7, 8·5 : 133° : 2″·3.

Σ **1607.** XII^{h} 5^{m}, N 36° 45′ : 7·8, 8·3 : 350°·3 : 33″·1 : wh. Moving.

Σ **1776.** XIII^{h} 37^{m}, N 46° 48′ : 8, 8 : 200°·2 : 7″·3 : wh.

Σ **1758.** XIII^{h} 28^{m}, N 49° 45′ : 8, 8·2 : 311°·4 : 4″·2 : wh. (Bird yel.)

Σ **1789.** XIII^{h} 49^{m}, N 33° 23′ : 8, 8·2 : 326° : 6″·1 : v. wh.

Σ **1702.** XII^{h} 53^{m}, N 38° 55′ : 8, 8·5 : 82°·7 : 35″·7 : yelsh. wh., wh. (2^{m} 30^{s} *f*, 1′*s*, from 12.)

Σ **1642.** XII^{h} 20^{m}, N 45° 25′ : 8, 8·8 : 183°·2 : 2″·8 : wh. (Bird beautiful field.)

Σ **1653.** XII^{h} 27^{m}, N 32° 41′ : 8·3, 8·5 : 343°·2 : 7″·8 : wh.

Σ **1613.** XII^{h} 7^{m}, N 36° 27′ : 8·5, 8·8 : 18°·5 : 1″·6 : wh.

Σ **1679.** XII^{h} 41^{m}, N 50° 28′ : 8·5, 9 : 208°·3 : 5″·5 : wh.

Σ **1718.** XIII^{h} 0^{m} : N 51° 37′ : 8·5, 9 : 272°·4 : 13″·1 : wh.

Red Stars. 21. XIII^{h} 13^{m}, N 50° 19′ : 5 m^{g}., has fine red star 8·5–9 m^{g}. in field, with *comes* 11 m^{g}. bl.

B 290. XII^{h} 39^{m}, N 46° 6′ : 5·5.

B. A. C. 4628. XIII^{h} 46^{m}, N 35° 15′ : 6 : or. red. *np* 5 m^{g}. or. Fr.

[CANES VENATICI]

Nebulæ.

3572 (M 51). XIII^h 25^m, N 47° 49′. E. of Rosse's wonderful spiral: its wreaths of stars are beyond all but the first telescopes; common ones will only show two very unequal nebulæ nearly in contact, both brightening in the centre: traces of the halo encompassing the larger may perhaps be caught; Sm could not do more: 'the enigma is another unequivocal mark of the illimitable power of the SUPREME CREATOR!' [9½ in. spec. showed plainly outer end of spiral, and junction with smaller neb.] E. of Rosse resolvable. Huggins spectrum not gaseous. A misty spot in finder, 3° *s p* Alkaid, at end of Great Bear's tail.

3636 (M 3). XIII^h 37^m, N 28° 58′. 'A brilliant and beautiful globular congregation of not less than 1,000 small stars' (Sm), *blazing* splendidly (that is, running up into a confused brilliancy) towards the centre, with many outliers. H 11–15 m^g., making lines and irregular rays. $3\frac{7}{10}$ in. hardly resolved it. Buffham centrally resolved, 9 in. 'With' mirror; [sprinkled over and surrounded by the larger stars, 9½ in. spec.] In a triangle of stars, rather nearer Arcturus than Cor Caroli.

3258 (M 94). XII^h 45^m, N 41° 47′. Small bright neb. like a comet; H a nucleus; E. of Rosse spiral? A little *p* Cor Caroli, 2½° *n*.

3474 (M 63). XIII^h 10^m, N 42° 40′. Oval, not bright. HH saw it 9′ or 10′ long, and near 4′ broad, with a very brilliant nucleus. An 8 m^g. star lies *p*, a minute triplet *f*. Huggins continuous spectrum.

(3002 (HH I 213). XII^h 22^m, N 44° 45′. Oval, resolved.—*d'A* unequally double.)

[CANES VENATICI]

(3042 (H I 198). XII^h 24^m, N 42° 18′. Long, easily resolvable.—d'A a small faint neb. *n p*.)

(2723 (H I 195). XII^h 1^m, N 43° 44′. Oval, with nucleus.—d'A resolved.)

(3165 (H V 42). XII^h 36^m, N 33° 12′. Very long ray (d'A 13′). A small star *p*, and beyond it small faint neb.)

(2972 (H I 77). XII^h 21^m, N 31° 53′. Long; nucleus like star 11 m^s.)

(3437 (H I 96). XIII^h 5^m, N 37° 42′. Long; nucleus.)

CANIS MAJOR.

α (Sirius). VI^h 40^m, S 16° 33′. This is the leader of the host of heaven: a glorious object, in all likelihood either far greater or more splendid than our Sun. It has been perceived at midday with ½ in. aperture. Hevel and Bond II. saw it with the naked eye in broad sunshine; and Plummer has seen a shadow cast by it. Its colour has probably changed. Seneca called it redder than Mars; Ptolemy classed it with the ruddy Antares. I now see it of an intense white, with a sapphire tinge, and an occasional, probably atmospheric, flash of red. Hind and Pogson have found similar decided changes of colour in variable stars. In the spectrum of Sirius, and many white stars, the lines of hydrogen are abnormally strong, all those of the metals remarkably faint. The very minute parallax of Sirius indicates, according to Hind, nearly seventeen years of light-passage—an inconceivable distance, far surpassing, probably, that of many telescopic stars. From irregularities in the proper motions of Sirius and Procyon, Bessel fully believed that each was a member of a binary system, their companions

being dark and invisible. This remarkable idea has been, to some extent, justified by A. Clark's discovery in 1862 of a 10 m^{g}. star, nearly at the required distance and angle, a most interesting object, which would not be difficult but for want of greater elevation on the meridian. Bond 84°·5 : 10″·1, 1862; Se 71°·3 : 10″·1, 1866; Bu 52°·4 : 10″·8, 1878. OΣ thinks its mass must be at least half that of Sirius, but its nature very different or it would shine as a 1 m^{g}. star. D asks, 'Is it an enormously large globe endued with very small light-producing power? or perhaps shining by reflection from Sirius?' 5 other companions were seen by Goldschmidt (?) Spectroscopic observations have led Huggins to the conclusion that Sirius was in 1868 receding from us with a velocity of 18 to 22 miles per second.—Vogel raises this to 46 miles.

Double Stars.

μ (Σ **997**: 4·7, 8). VI^{h} 51^{m}, S 13° 53′ : 5·5, 9·5 : 342°·9 : 3″·5 : topaz yel., grey. 3° *n f a*, among rich fields.

ν^{1}. VI^{h} 31^{m}, S 18° 34′ : 6·5, 8 : 260°·2 : 17″·2 : pale garnet, grey. 3° *s p a*.

30. VII^{h} 14^{m}, S 24° 44′ : 6·5 (5·4 Heis), 9 : 73° : 85″ : wh., pale grey. H 6·5 triple : 11, 12 : 85°·8, 73°·3 : est. 8″, 15″. In rich cluster, ℍ VII 17. [About 1° 50′ *n*, 1° *p*, lies a very fine pair, 6·5, 8 : fiery red, grnsh. bl.]

Σ **1011.** VI^{h} 55^{m}, S 15° 9′ : 8, 8·5 : 295°·7 : 4″·5 : wh.

Σ **971.** VI^{h} 43^{m}, S 13° 19′ : 8·2, 8·5 : 331° : 1″·9 : o, o, 1829. (Cincinnati 324°·9 : 1″·6, 1878.)

Σ **1069.** VII^{h} 12^{m}, S 13° 31′ : 8·3, 8·3 : 193°·3 : 25″·4 : wh.

Σ **1031.** VII^{h} 3^{m}, S 13° 47′ : 8·3, 9 : 251°·6 : 3″·8 : o, o.

Σ **970.** VI^{h} 42^{m}, S 11° 36′ : 8·5, 9 : 128°·6 : 20″·1 : o, o.

Σ **990.** VI^{h} 49^{m}, S 14° 6′ : 8·7, 9·3 : 274°·9 : 3″·3 : wh.

[CANIS MAJOR]

(Ll **12936**. VI^h 37^m, S 15° 54′.—Bu 7, 10; De 6·7, 9 : 165° : 3″·5, 1876. *n p a*.)

Red Stars. B 3 Add. *z*. VI^h 12^m, S 16° 46′ : 5·5.

[B 166. VII^h 2^m, S 11° 44′ : 7·5. In fine group.]

Clusters.

1454 (M 41). VI^h 42^m, S 20° 37′. Superb group, visible to naked eye, 4° beneath *a*. Larger stars in curves, with ruddy star near centre, 5½ in. — H says the latter frequently occurs in clusters. See also note on Sagittarius, *infra*.

1512 (ℍ VII 12). VII^h 12^m, S 15° 25′. Beautiful cl. H 10 m^g. melting into a very rich neighbourhood, as though the Galaxy were approaching us. 64 includes a bright wh. star *p*. Sm notes that the stars are nearly all 10 m^g.—3° *f γ*.

CANIS MINOR.

a (Procyon). VII^h 33^m, N 5° 32′. A fine pale yel. star (which see under Sirius[1]) with a light-passage of more than 26 y., has several minute attendants in a large field. One, 5½^m *f a*, was found double by Bird, with 12 in. silv. mirror, 1864, 9·5, 9·8; seen by Buffham with 9 in. do. 'With,' and detected independently with 6 in. achr. by Bu, as well as by De, who gives 185°·9 : 0″·87, 1871. Severe test. Lamont minute companion *n p* : D just sees it steadily with 8½ in. achr. and gives it 11·8 m^g. (of Σ); Bu 317°·3 : 44″·6. Wa pretty pair 35′ *n* of *a*, and 2 *comites* to star 10 m^g. *p a*. Vicinity very rich in small pairs and triplets.

[1] Vogel at Bothkamp thinks, from spectroscopic observations, Procyon may be receding from us 63 miles per second, Sirius 46.

[CANIS MINOR]

Double Stars.

14. Triple. VII^h 52^m, N 2° 33′ : 6, 8, 9 : 64°·9, 153°·4 : 75″, 115″ : pale wh., 1831, blsh., bl. [6 deep yel. 1851, and 8 very little brighter than 9 ; so Sa 1876 ; Fr 6 full yel., 8, 9 equal, 1877.]

P VII 170 (Σ **1126**: 7·2, 7·5). VII^h 34^m, N 5° 30′ : 7, 8 : 132°·9 : 1″·4 : wh., ashy. [Discs in contact, 144 ; occasionally just split, 250 ; divided by disc of 7, 9$\frac{1}{8}$ in. spec. 460. Admirable test, lying most conveniently *f* a little *s* of *a*, and being the largest star in that direction.] Amici discovered *comes* ; Sa with 2$\frac{1}{2}$ in. est. 13 : 240° : 25″. It is often called 31 Can. Min. Bode. Slow bin. [About 1° *s f* is a fine or. 7 or 8 m^g. star.]

Bu **21** (*η*). VII^h 22^m, N 7° 11′ : De 5·5, 11·3 : 27°·4 : 4″·1.

Σ **1143**. VII^h 42^m, N 7° 45′ : 7, var. often unseen : 152° : 9″·3 : yel., o.

OΣ **182**. VII^h 46^m, N 3° 41′ : 7, 7·5 : 47° : 1″·1.

Σ **1103**. VII^h 24^m, N 5° 30′ : 7, 8·5 : 244°·5 : 4″·3 : v. wh., ash.

Σ **1182**. VII^h 59^m, N 6° 12′ : 7, 9 : 72°·6 : 4″·4 wh., o.

Σ **1116**. VII^h 28^m, N 12° 34′ : 7, 7·7 : 111° : 1″·8 : wh.

Σ **1149**. VII^h 43^m, N 3° 33′ : 7·3, 9 : 40°·3 : 22″ : yel., wh. [yelsh., blsh. Pretty.]

OΣ **170** (P VII 52). VII^h 11^m, N 9° 31′ : 7·5, 7·5 : 120°·6 : 1″·2 : yel.

Σ **1067**. VII^h 13^m, N 3° 6′ : 7·7, 8·7 : 265°·5 : 25″·6 : wh.

Σ **1082**. VII^h 17^m, N 10° 56′ : 8, 8·7 : 326°·5 : 19″·9 : wh

Σ **1137**. VII^h 40^m, N 4° 26′ : 8, 9 : 132°·7 : 2″·8 : yelsh., bl.

[CANIS MINOR.]

Σ **1181.** VII^h 59^m, N 8° 35′ : 8, 9·5 : 140°·3 : 5″·2 : yelsh., blsh.

Σ **1095.** VII^h 21^m, N 9° 0′ : 8·3, 8·8 : 78° : 9″·8 : v. wh.

Σ **1130.** VII^h 35^m, N 10° 0′ : 8·4, 8·9 : 162° : 2″ : o, o.

Σ **1099.** VII^h 23^m, N 11° 48′ : 8·4, 9 : 343°·4 : 4″ : v. wh.

Σ **1114.** VII^h 27^m, N 9° 35′ : 8·5, 9 : 53°·6 : 6″·5 : wh. [Pretty group.]

Σ **1076.** VII^h 15^m, N 4° 17′ : 8·7, 8·7 : 106°·7 : 2″·7 : wh.

New Star. VII^h 35^m, N 8° 40′ : 6·8 : or. (1879.)—Baxendell.

Vars. R. VII^h 2^m, N 10° 14′ : 7·2, 7·9—9·5, 10 : 329^d ? red.

S. VII^h 26^m, N 8° 34′ : 7·2, 8—below 11 : 332^d.

T. VII^h 27^m, N 12° 0′ : 9·1, 9·7—below 13 : 325^d.

CAPRICORNUS.

Not a conspicuous constellation, but containing some good objects, among which its principal star takes a high rank.

Double Stars.

α^2, α^1 (Σ 51 App. I : 3·2, 4·2). XX^h 11^m, S 12° 55′ : 3 (α^2), 4 (α^1) : 291°·4 : 373″·4 : pale yel., yel. ; Σ cols. exactly alike, 1835. A noble pair, obvious to naked eye. α^2 has a 16 m^g. companion at 5″, just seen once by Sm, obvious to Sa with 6½ in. spec. and Bu with 6 in. achr. at Chicago. Buffham sees it with 9 in. spec. and Ward with $4\frac{3}{10}$ in. achr. Alvan G. Clark has doubled it, est. 250° : 1″·5 : Sa wide, Common's 18¼ in. spec.

β^2 (Σ 52 App. I : 2·5, 6). XX^h 14^m, S 15° 10′ : 3·5, 7 : 267°·2 : 204″·8 : or. yel., sky-bl. Very minute pair between them.—H 15, 16 : 325° : 3″. Very fine large field.

[CAPRICORNUS]

ρ. xx^h 22^m, S 18° 13′ : 5, 9 : 176°·7 : 3″·8 : wh., pale bl., 1830; a 7·5 m^g. yel. star f considerably s. [Pale yel., ruddy purp., 1850 : 7·5, a fine addition, viol. or lilac.] Bu excessively difficult *comes* between ρ and 7·5 ; Sa easy, $6\frac{1}{2}$ in. spec.

σ. xx^h 13^m, S 19° 30′ : 5·5, 10 : 176°·8 : 54″·1 : yel., viol., 1837 [or., bl., 1850 : companion underrated ? so Fr 1876 : yel., ruddy, 9 in. spec. 1870 ; and 10 m^g.]

o^2. xx^h 23^m, S 18° 59′ : 6, 7 : 239°·9 : 21″·8 : blsh., 1832 [wh., blsh., 1850] so Fr 1876.

Bu **60** (π). xx^h 20^m, S 18° 36′ : De 5·1, 8·7 : 145°·2 : 3″·3.—Discovered by Mitchel.

Σ **2826**. xxi^h 41^m, S 13° 41′ : 8, 8·5 : 82°·5 : 4″·3 : wh.

Σ **2683**. xx^h 21^m, S 13° 30′ : 8, 8·5 : 67°·1 : 22″·8 : wh.

Σ **2699**. xx^h 30^m, S 13° 6′ : 8, 9 : 192°·2 : 9″·6 : wh.

Σ **2678**. xx^h 19^m, S 8° 41′ : 9, 9·2 : 320°·7 : 3″·5 : 0, 0.

[About xx^h 39^m, S $15\frac{1}{2}$°, is a pretty pair, 8, 9 : lilac, perhaps blsh. grn. (H 1567) $1\frac{1}{4}$° f P XX 240, a little n.]

[Red star. B 545. xx^h 10^m, S 21° 41′ : 7 m^g. pure ruby ; H ; perhaps his finest, but very low in the English sky. B and Webb not very deep. Gore 8·5 m^g. 1875 : var. ?]

Vars. R. xx^h 5^m, S 14° 37′ : 8·8, 9·7—below 13 : 347^d : red.

T. xxi^h 15^m, S 15° 40′ : 8·9, 9·7—below 13 : 269^d.

U. xx^h 41^m, S 15° 13′ : 10·2, 10·8—below 13 : 203^d.

Nebula.

4687 (M 30). xxi^h 34^m, S 23° 42′. Moderately bright :

[CAPRICORNUS]

beautifully contrasted with an 8 m^{g}. star beside it: comet-like with 64: with higher powers resolvable (into 12 m^{gs}. H).—'What an immensity of space is indicated! Can such an arrangement be intended, as a bungling spouter of the hour insists, for a mere appendage to the speck of a world on which we dwell, to soften the darkness of its petty midnight? This is impeaching the intelligence of Infinite Wisdom and Power, in adapting such grand means to so disproportionate an end. No imagination can fill up the picture of which the visual organs afford the dim outline; and he who confidently probes the Eternal Designs cannot be many removes from lunacy.' (Sm.) It lies closely *p*, a little *n* from 41, a 5 m^{g}. star.

CASSIOPEA.

Here lie a multitude of superb Galaxy fields. The leader *α* is a slightly var. 2 m^{g}. to 2·5 m^{g}. in 79·1^{d}. Birt gives 50·98^{d}., but Schm perceives no change. Snow always found it sharper and smaller, and more readily obscured by fog than *β* or *γ*, even when equally bright.[1]

[1] A difference in the *aspect* of different stars, independent of magnitude, and sometimes of colour, has been noticed by several observers. Sm, speaking of a dull 11 m^{g}. star seen best by averted vision, remarks that 'there are many of much smaller magnitudes which shine quite sharply, and emit a strong blue ray.' Key says, 'We constantly meet with stars which loom large with a faint light, and others again very vivid, but contracted apparently to a point.' Babinet remarks that some stars have a peculiar power of overcoming twilight. A gives *ζ* Aur. as a striking instance, among others, of singularly intense light for its magnitude. He says that the red and yellow stars appear brighter in proportion to the superiority of the eye and instrument. Schm finds that red stars gain in twilight, lose by night, as compared with white ones, and that the position of the eyes is of material consequence in such estimates.

[CASSIOPEA]

Double Stars.

γ. 0^h 49^m, N 60° 4′ : 3 m^g. : Se and Huggins find double spectrum like that of T Cor. Inserted for its beautiful contrast with the minute surrounding stars. About ½° *s* Ingall has pointed out a pretty little pair; red, bl., 1865; Grover 8, 8·5 : est. 180° : 10″.

η (Σ **60** : 4, 7·6). 0^h 42^m, N 57° 11′ : 4, 7·5 : 87°·8 : 9″·8, 1830 (K 125°·6 : 6″·8, 1865; Gl 147°·2 : 5″·8, 1876) : pale wh., purp., 1843; H and South red, grn.; Σ yel., purp., 1832; so Fletcher, 1851; D yel., bl., 1841; Miller wh., dusky or., 1851; P Sm yel., Indian red, 1856; [yel., garnet, 1850.] Bin. : period Do 222 y. Grüber 195 y. Du 176 y. Great c. p. m. Light-passage 21 y.

P II 72 (Σ **262** : 4·2, 7·1, 8·1). Triple. 11^h 19^m, N 66° 52′ : 4·5, 7, 9 : 274°·2, 107°·1 : 2″·1, 7″·5, 1834 (De 265°·9 : 1″·9, 1862; Gl nearly so 1874) : yelsh. wh., purpsh., fine bl. : *ι* of Σ, A, Se: Hevel 35. C. p. m. [Fine but not easy, $3\frac{7}{10}$ in. 1850.]

ψ (Σ **117** : 4·4, 8·9). 1^h 17^m, N 67° 30′ : 4·5 (var. ?), 9 : 102°·1 : 31″·9, 1836 (De 105°·1 : 29″·7, 1865) : gold. yel., ashy. 9 again double [5½ in. showed it well], 252°·6 : 2″, 1836; Σ 8·9, 9·5 : 253°·3 : 3″, 1831; De 255°·3 : 2″·8, 1865; Ferrari 267°·3 : 3″·1, 1874.

P XXIII 101, 100 (OΣ 496). $XXIII^h$ 24^m, N 57° 53′ : 5, 7·5 : 270°·5 : 74″·1 : light yel., wh., 1830; pale wh., yelsh., 1852 [7·5 pale lilac, 1854; so Fr 1877]. D has doubled 7·5; 222°·3 : 1″·5, 1841. Perry easy, 6½ in. Calver spec. 1880. Another star 14 m^g. lies 345° : 20″ from it. [A 10 m^g. pair *p* 5; De 9·2, 9·6 : 73°·5 : 10″·3.]

σ (Σ **3049** : 5·4, 7·5). $XXIII^h$ 53^m, N 55° 5′ : 6, 8 : *323°·7* : 3″ : flushed wh., 1838 (Du pale grn., 1869, 1870; *so* Sa 1875), smalt bl. Glorious low-power field.

[CASSIOPEA]

Bu **513** (48). $1^h\ 52^m$, N 70° 19′ : 5, 7·5 : 264°·4 : 1″.

OΣ **508** (6). $XXIII^h\ 43^m$, N 61° 33′ : 5·7, 8·2 : 196°·2 : 1″·7 : v. yel., o.

Σ **3053**. $XXIII^h\ 57^m$, N 65° 24′ : 6, 7·3 : 70° : 15″·2 : v. yel., bl.

Σ **131**. $1^h\ 26^m$, N 60° 5′ : 6, 9·2 : 142°·4 : 13″·6 : yelsh., o.

Σ **163**. $1^h\ 43^m$, N 64° 16′ : 6·2, 8·2 : 33°·6 : 35″ : red gold, blue; remarkable cols. [M^{es}. high ? cols. splendid.]

Σ **191**. $1^h\ 53^m$, N 73° 17′ : 6·2, 8·5 : 190°·1 : 5″·6 : wh., bl.

Σ **60**^{1}. $XXIII^h\ 29^m$, N 59° 47′ : 6·4, 6·5 : 210°·6 : 247″·2 : yel.

Σ **30**. $0^h\ 21^m$, N 49° 22′ : 6·8, 8·7 : 295°·9 : 21″·2 : wh., ash.

Σ **182**. $1^h\ 48^m$, N 60° 43′ : 7, 7 : 302° : 3″·6 : yelsh. wh. [Very pretty.]

Σ **3037**. $XXIII^h\ 40^m$, N 59° 48′ : 7, 8·5 : 214° : 2″·7 : v. yel., bl.—Triple; 8·9 : 184°·4 : 28″·9.

Σ **306**. $11^h\ 42^m$, N 59° 55′ : 7·1, 9 : 93°·4 : 2″·1 : yelsh. wh., o.

Σ **59** (P O 181). $0^h\ 41^m$, N 50° 47′ : 7·2, 8·1 : 145° : 2″·2 : v. wh. (Fl bin. and c. p. m.)

OΣ **33**. $1^h\ 29^m$, N 58° 1′ : 7·2, 8·3 : 74°·4 : 24″·3 : yelsh., o.

OΣ **50**. $111^h\ 0^m$, N 71° 5′ : 7·5, 7·5 : 216°·1 : 1″·1. wh.

OΣ **23**. $1^h\ 3^m$, N 51° 6′ : 7·5, 8 : 193° : 14″·6 : yelsh.

Σ **16**. $0^h\ 10^m$, N 53° 59′ : 7·7, 9 : 38°·2 : 5″·5 : v. wh. (Bird in a vertical curve.)

Σ **96** (P O 312). $1^h\ 5^m$, N 64° 24′ : 7·8, 8·8 : 280°·9 : 1″·3 : wh.

Bu **394**. $0^h\ 24^m$, N 46° 52′ : 8, 8 : est. 300° : 1″.

Σ **65**. $0^h\ 45^m$, N 68° 12′ : 8, 8 : 35°·1 : 3″ : v. wh.

[CASSIOPEA]

Σ **130.** 1h 26m, N 69° 18′ : 8, 9 : 187°·7 : 7″·5 : yelsh., ash.

Σ **148.** 1h 38m, N 63° 13′ : 8·4, 9 : 130°·4 : 1″·4 : wh.

Σ **97.** 1h 5m, N 50° 53′ : 8·5, 8·7 : 98°·6 : 4″·5 : v. wh.

Σ **3047.** XXIIIh 52m, N 56° 43′ : 8·7, 8·7 : 65°·6 : 1″·2 : yelsh. wh. (Fl bin. Bu triple, 12.)

Σ **3038.** XXIIIh 40m, N 61° 59′ : 9, 9·5 : 275° : 4″·4 : wh.

[β, 2½ mg. 0h 3m, N 58° 29′ is a pointer to two pretty pairs, a short distance *s p*. The *p* one is Σ **3057.** 7·2, 9·3 : 299°·6 : 3″·6 : yelsh., ashy. The closer and more interesting is Σ **3062.** 6·8, 7·9 : 36°·7 : 1″·3, 1823; 132°·6 : 0″·4, 1835; K 269°·9 : 1″·4, 1865; 282°·7 : 1″·4, 1872; De 295°·7 : 1″·5, 1877 : yel.; D wh. 1843. Rapid bin. M 147, Schur 113 y. Nearer β is a curious 8 mg. triangle, suggesting (as so many others) actual, not optical vicinity. Bu one an excessively close pair.—Fine region a little *f*.]

(Quintuple. 12m *f*, 6′ *n*, from *a*. Bu 7·5, 11 (at 1″·5), 8·5, 10, 15.)

(Σ **188** rej. 1h 50m, N 62° 19′ : H 9, 10 : 236°·6 : est. 40″ : v. red, fine grn.)

Red Stars. B 31. 1h 47m, N 69° 37′ : 8.

[B 658. XXIIIh 55m, N 59° 41′ : 7·8 var. with blue 9 mg. *comes*.]

Temporary star. 0h 19m, N 63° 24′. According to A, it was near this spot that the Great New Star flamed out, November, 1572, speedily rivalling Venus, so as to be seen at noon-day, then fading during 16 months to utter extinction: there is some idea that similar appearances took place here in 945 and 1264; if so, we may possibly soon witness a repetition of this incomprehensible phænomenon. d'A found a minute star, 10·11 mg. near its place, 1865, where A could formerly *see none*. So Es 1878. This should be watched. The

[CASSIOPEA]

colour of the great star changed from wh. through yel. and red to bl. Hind thinks that several var. stars increase bl., are yel., after maximum, and flash red in decreasing.

Vars. R. XXIII^h 52^m, N 50° 43′: 4·8, 6·8—below 12: 425^d, decreasing: very red.

S. 1^h 11^m, N 71° 59′: 6·7, 8·5—below 13: 615^d; increase quicker than decrease: red.

T. 0^h 17^m, N 55° 8′: 6·5, 7—11, 11·2: 436^d, uncertain: red.

Clusters and Groups.

382 (H VI 31). 1^h 38^m, N 60° 38′. Visible in finder; field very good, 64; 80 showed Sm's little pair (Σ **153**: 8·5, 9·7) 9, 10·5: 70°: 8″; but not his ruby 8 m^g. 1833. 2½° from δ, on line from α.

341 (M 103). 1^h 25^m, N 60° 2′. Beautiful field. 1° *f* a little *n* of δ.

κ. 0^h 26^m, N 62° 16′: 4: bright yel. 1837 [wh. 1850, a little yelsh. 1855] stands in a grand region. [One group resembles a capital Y.]

256 (H VII 42). 1^h 12^m, N 58° 9′: is a very elegant group attending φ, 5 m^g. [The 2nd star lilac.] Red star, 8 m^g. 30′ *s*, a little *f*.

120 (H VIII 78). 0^h 37^m, N 61° 8′. Fine cl.: somewhat like the letter W; half way from γ to κ.

5031 (H VI 30). XXIII^h 51^m, N 56° 3′. Beautiful large faint cloud of minute stars: H 11—18 m^g.: 'A most superb cluster;' 'a mere condensed patch,' as Sm remarks, 'in a vast region of inexpressible splendour, spreading over many fields;' including the whole Galaxy through this and the adjacent constellations. [A beautiful group in a rich field lies about ¾° *f* δ. Glorious region between π and υ.]

CEPHEUS.

Much more barren to the naked eye than to the telescope. Splendid sweeps and curious groups between α and Galaxy.

Double Stars.

β (Σ **2806** : 3, 8). $21^h\ 27^m$, N 70° 2′ : 3, 8 : 251° : 13″·7 : wh., bl., 1833, 1843; yelsh., flushed bl., 1851, De yel., viol., 1852, 1854; [wh., bl., 1850.] Cornish 3 decreasing 1879.

δ (Σ 58 App. I : 3, 5·3). $22^h\ 25^m$, N 57° 48′ : 4·5, 7 : 192°·2 : 40″·9 : deep yel., cerul. bl. Especially fine pair, somewhat like β Cyg. C. p. m. 4·5 is very regularly var. up to 3·5 : period $5^d\ 8^h\ 30^m$: A adds 18^m. Schm suspects variation in many stars of Cepheus.

κ (Σ **2675** : 4, 8). $20^h\ 13^m$, N 77° 21′ : 4·5, 8·5 : 123°·8 : 7″·5 : pale yel., bl. Se suspects motion, but?[1]

ξ (Σ **2863** : 4·7, 6·5). $22^h\ 0^m$, N 64° 3′ : 5, 7 : 288°·8 : 5″·8, 1839; Gl 284°·8 : 6″·6, 1874 : blsh., 1839; flushed, pale lilac, 1851; Σ pale yel., bl., 1831; De wh., viol., 1854; Du pale grn., purp., 1879; [wh., tawny or ruddy, 1850.] Bin. C. p. m. About 1° n, and as much p, is Σ **2843**, 7, 7·2 : 133°·5 : 2″·4 : yelsh. [not examined].

π. $23^h\ 4^m$, N 74° 44′ : 5, 10 (0Σ 7·5) : 330° : 1″·8, 1843;

[1] A peculiarly strange coincidence is too remarkable to be omitted, attested by an unimpeachable witness, the late Mr. Baily. 'The RA of this star was erroneously calculated by the two separate and independent computers, who *agreed precisely in every figure*: and the error was even unobserved by the vigilant eye of Mr. Stratford. On recomputing the place of this star, with a view to discover the cause of its discordancy, I myself fell into exactly the same error, and obtained *precisely the same figures;* and it was only on going over the operation a second time that I *accidentally* discovered that we had all inadvertently committed the *same* mistake!'—*Memoirs of R. Astron. Soc. IV. 290.*

[CEPHEUS]

De 23°·9 : 1″·3, 1876 : deep yel., purp. [not seen]. Bin.

P XXII 11, 12. XXII^h 5^m, N 58° 42′ : 6 (Σ 7·2), 6·5, 1839 : [v. nearly equal, 1850; so Fr 1876] : 316°·8 : 21″·4 : wh. Σ doubles 6·5 (**2872**) bin. Just p λ : a little n of ζ.

P XXI 248 (Σ **2816** : 6·3, 7·9, 8). Triple. XXI^h 35^m, N 56° 57′ : 6, 8·5, 8·5 : 120°·3, 339°·5 : 11″·7, 19″·7 : pale yel., two grey.

P II 191 (Σ **320** : 6·3, 9.5). 11^h 50^m, N 78° 57′ : 6, 10·5 : 225°·8 : 5″·2, 1834 (Σ 4″·4, 1831), or., smalt bl. Test for moderate instruments.

o (Σ **3001** : 5·2, 7·8). XXIII^h 14^m, N 67° 27′ : 7 (P; De 5), 9 : 173°·8, 1831 (Do 191°·6, 1877) : 2″·5 : or. yel., deep bl. Bin. C. p. m.

P XXI 51 (Σ **2780** : 6·2, 7·2). XXI^h 9^m, N 59° 30′ : 6·5, 7·5 : 229°·5 : 1″·3 : wh. [B 579, pale ruby, 7·5 m^g. $n f$.]

Σ **2893**. XXII^h 11^m, N 72° 44′ : 5·5, 7·6 : 348°·6 : 28″·8 : yelsh., wh.

Σ **2790**. XXI^h 16^m, N 58° 7′ : 5·6, 9·9 : 46°·6 : 4″·5 : v. red, bl., 1832. (Se 5·6 yel. 1857. [or., 9 in. spec. 1871.]

Σ **2950**. XXII^h 46^m, N 61° 4′ : 5·7, 7 : 319°·1 : 2″ : yel., ash. (Fl naked-eye star, yet missed by F, P, and Ll.—Ferrari 312°·1 : 2″·5 : 1874.—Bin. ?)

Σ **2751**. XX^h 59^m, N 56° 12′ : 6, 7 : 344°·1 : 1″·9 : v. wh. (Fl slow bin.)

Σ **2840**. XXI^h 48^m, N 55° 14′ : 6, 7 : 194°·1 : 20″ : grnsh. wh., blsh. wh.—[A splendid pair.]

Σ **2873**. XXII^h 3^m, N 82° 17′ : 6·2, 7 : 77°·3 : 13″·8 : wh., 1832. (Fr yelsh., blsh., 1876.)

Σ **2883**. XXII^h 8^m, N 69° 32′ : 6·2, 8·2 : 254°·7 : 14″·9 : blsh. wh., bl., 1833. (Fr 6·2 yelsh., 1876.)

[CEPHEUS]

Σ **57**[1]. XXI^h 32^m, N 66° 12′ : 6·5, 6·5 : 26°·1 : 179″·1 : yelsh.

Σ **2687.** XX^h 24^m, N 56° 15′ : 6·5, 8·3 : 119° : 26″·2 : wh., ash.

Σ **170.** I^h 45^m, N 75° 40′ : 6·7, 7·5 : 246°·8 : 3″·2 : yelsh. wh., blsh. wh.

Σ **2923.** XXII^h 30^m, N 69° 45′ : 6·9, 9·2 : 46°·4 : 9″·3 : wh., ash.

Σ **48.** O^h 35^m, N 70° 42′ : 7, 7·2 : 333° : 5″·5 : v. wh.

Σ **2803.** XXII^h 18^m, N 66° 6′ : 7, 8 : 96°·5 : 4″·2 : yel., bl.

Σ **185.** I^h 51^m, N 74° 56′ : 7, 8·5 : 40°·3 : 1″·4 : wh. (1831. Bird not divided, 1872. Yet OΣ 1″·8, 1872.)

Σ **2948.** XXII^h 45^m, N 65° 55′ : 7, 8·7 : 5°·3 : 2″·8 : yelsh. wh., blsh. wh.

Σ **3017.** XXIII^h 23^m, N 73° 29′ : 7·1, 8·2 : 35°·4 : 2″·4 : wh.

Σ **2947.** XXII^h 45^m, N 67° 55′ : 7·2, 7·2 : 76° : 3″ : wh. (Slow bin.)

Σ **419.** III^h 30^m, N 69° 27′ : 7·2, 7·2 : 73° : 3″·1 : v. wh.

Σ **3052.** XXIII^h 56^m, N 70° 42′ : 7·2, 7·8 : 7°·9 : 33″·5 : wh.

OΣ **451** (P XXI 328). XXI^h 48^m, N 61° 3′ : 7·2, 8·2 : 222°·9 : 4″·5.

Σ **2801.** XXI^h 22^m, N 79° 50′ : 7·3, 8 : 273°·1 : 1″·4 : yel., ashy yel.

Σ **2971.** XXII^h 54^m, N 77° 51′ : 7·3, 8·5 : 5°·2 : 5″·3 : yelsh., ash.

Σ **2796.** XXI^h 17^m, N 78° 5′ : 7·3, 8·8 : 43°·8 : 24″·6 : wh., ashy.

Σ **3133.** XX^h 55^m, N 60° 52′ : 7·4, 8·9 : 102°·4 : 3″·6 : *yelsh.*, ash.

[CEPHEUS]

O Σ **480.** $22^h\ 41^m$, N 57° 26′ : 7·5, 8·2 : 117°·3 : 30″·9.

Σ **2819** (P XXI 256). $21^h\ 36^m$, N 57° 1′ : 7·5, 8·5 : 57°·2 : 12″·4 : wh.

Σ **2810.** $21^h\ 31^m$, N 58° 34′ : 7·5, 8·5 : 290° : 16″·9 : o, o.

Σ **2896.** $22^h\ 15^m$, N 62° 37′ : 7·5, 8·5 : 241°·9 : 21″·5 : wh., blsh.

Σ **2326.** $18^h\ 17^m$, N 81° 27′ : 7·7, 8·7 : 201°·7 : 15″·6 : wh., ash.

Σ **2860.** $21^h\ 59^m$, N 60° 16′ : 7·7, 9·3 : 250°·8 : 3″·3 : v. yel., bl., 1832. (De 254°·6 : 5″·2, 1864.)

Σ **2963.** $22^h\ 52^m$, N 75° 45′ : 7·8, 8·5 : 354°·4 : 2″·4 : wh.

Σ **2783.** $21^h\ 11^m$, N 57° 48′ : 8, 8 : 43°·2 : 1″·3 : wh.

Σ **2961.** $22^h\ 52^m$, N 62° 15′ : 8, 8 : 348°·6 : 2″ : wh.

Σ **2764.** $21^h\ 3^m$, N 61° 41′ : 8, 8·5 : 302°·2 : 6″·8 : wh.

Σ **2845.** $21^h\ 49^m$, N 62° 31′ : 8·2, 8·3 : 169° : 2″·2 : yelsh. wh. (Fl bin. ?)

Σ **2807.** $21^h\ 25^m$, N 82° 1′ : 8·2, 8·3 : 319°·6 : 2″·4 : wh.

Σ **2870.** $22^h\ 4^m$, N 60° 31′ : 8·2, 9·2 : 271°·6 : 5″·4 : wh.

Σ **2766.** $21^h\ 4^m$, N 58° 31′ : 8·3, 8·5 : 249°·3 : 5″·1 : wh.

Σ **2996.** $23^h\ 9^m$, N 81° 10′ : 8·3, 8·7 : 109°·2 : 4″·9 : wh.

Σ **199.** $1^h\ 56^m$, N 67° 7′ : 8·5, 8·5 : 21° : 35″·8 : wh.

Σ **2858.** $21^h\ 51^m$, N 86° 19′ : 8·5, 8·7 : 164°·3 : 15″ : wh.

Σ **3011.** $23^h\ 20^m$, N 76° 26′ : 8·5, 8·8 : 334°·8 : 6″·9 : wh.

Σ **2837.** $21^h\ 43^m$, N 82° 22′ ; 8·5, 9 : 321°·3 : 2″·2 : wh. (Bin.)

[CEPHEUS]

Σ **233.** $11^h\ 10^m$, N 75° 50′ : 8·5, 9 : 278°·4 : 2″·6 : wh.

Σ **2827.** $21^h\ 40^m$, N 63° 3′ : 8·5, 9 : 210°·6 : 4″·3 : wh.

Σ **2813.** $21^h\ 32^m$, N 56° 56′ : 8·5, 9 : 272°·8 : 10″·1 : wh.

Σ **2685.** $20^h\ 21^m$, N 63° 48′ : 8·5, 9·1 : 348°·8 : 4″·2 : wh.

Σ **34.** $0^h\ 25^m$, N 77° 27′ : 8·7, 8·8 : 334° : 5″·8 : o, o. (Bird minute *comes* to a star *f.*)

Σ **2812.** $21^h\ 31^m$, N 59° 10′ : 8·7, 9·2 : 126°·4 : 2″·1 : yelsh.

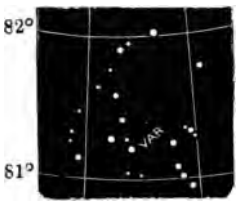
Σ **2771.** $21^h\ 3^m$, N 70° 15′ : 8·8, 8·8 : 212°·6 : 2″·7 : o, o.

Red Stars. *μ.* $21^h\ 40^m$, N 58° 14′. The celebrated 'Garnet sidus' of ℍ, visible to naked eye, but var. 4 mg. to 6 mg. in 5 or 6 y., and hence probably omitted by F. ℍ says 'it is of a very fine deep garnet colour,' especially after viewing a wh. star, such as *α*. 2½° *s* of *ν*. [Deep or., not crimson; 5½ in. 1864; so Slack, 1865; and 9⅓ in. spec. 1867.—Wide pair 45′ *p*, 10′ *n*.]

[B 579. $21^h\ 10^m$, N 59° 37′ : 7·5.]

B 599. $21^h\ 53^m$, N 63° 3′ : 5·7 : deep red or.

Vars. R. $20^h\ 17^m$, N 88° 46′ : 5 ?—10 ?



S. $21^h\ 37^m$, N 78° 5′ : 7·4, 8·5—11·5 : 485^d : red.

T. $21^h\ 8^m$, N 68° 0′ : 8·7—? reddish. Ceraski's 1st var.

U. $0^h\ 52^m$, N 81° 14′ : 7·2 blsh.—9·3 ruddy (K) : $2^d\ 11^h\ 50^m$. Ceraski's 2nd var., the most rapid yet known, of the type of Algol.

[CEPHEUS]

Incr. decr. and *min.* each 2 h. A diagram from one published by Lord Lindsay will assist in finding this wonderful object.

Cluster.

4957 (M 52). XXIII^{h} 19^{m}, N 60° 56′. Irregular, with or. star, as is frequently the case.

CETUS.

The largest, but far from the most interesting constellation. Its alphabetical leader *α* is now inferior to *β* : one or both may have changed. Huggins finds spectrum nearly as *α* Orion. *α* is worth looking at, as a fine combination of a beautiful 2·5 m^{g}. or. star with a 5·5 m^{g}. fine bl. Between them *f* is a pair 11 m^{g}., the *s* of which Wa doubles, 10, 11 : (Copeland 225° : 10″·25.) Gore two minute *comites* *p* α^{2}.

o. 11^{h} 13^{m}, S 3° 31′ : yel. (H v. full ruby; I found no trace of red, 1878; *α* was ruddier. Fl less red than gas-flame) : Mira, the celebrated variable, from 2 m^{g}. to about the brightness of a minute companion, which is suspected of being connected with it,[1] in 331^{d} 8^{h} 4^{m} 16^{s} according to A. Its maximum brightness and period are not always the same : A has shown the probability of regular alternations in the latter to the extent of 25^{d}. One of the most interesting problems of modern astronomy is the question whether the irregularities of variable stars may not be, like the *maxima* and *minima* of sun-spots, phases of some general law. Se a most curious columnar spectrum.

Double Stars.

γ (Σ 299 : 3, 6·8). 11^{h} 37^{m}, N 2° 44′ : 3, 7 : 285°·7 :

[1] Schönfeld gives *max*^{a}. 1·7, 5 ; *min*^{a}. 8, 9 (Σ's scale).

[CETUS]

2″·6 : pale yel., lucid bl., 1831–1843 : De 7 olive-grn., 1854; Fr ruddy or dusky, 1876 [tawny, 1850]. D angles very discordant. Fl very slow bin. C. p. m.

ν (Σ **281** : 5, 9·6). 11h 30m, N 5° 3′ : 4·5, 15 : 85° : 6″ : pale yel., bl. Sm 15 a glimpse-star; [easy, 5½ in., 1861; so Noble, 4·2 in. achr. 1873.]

94. 111h 7m, S 1° 39′ : 5·5, 16 : 260° : 5″ : pale cream col., dusky. Sm only glimpsed 16; H 19 mg. Bu not easy, 6 in. achr.

37 (Σ 3 App. I : 5·1, 7). 1h 8m, S 8° 34′ : 6, 7·5 : 332°·3 : 50″·6 : creamy wh., dusky. Σ c. p. m. *n p* lies another pair (Σ **101**), 8, 10 : 341°·1 : 20″·5 : yel., viol. 2° *p* θ.

42 (Σ **113** : 6·2, 7·2). 1h 14m, S 1° 8′ : 6, 8 : 332°·8, 1834 (De 343°, 1863 : 1″·2; Hall 351°·4 : 1″·25, 1876): bright wh., wh. Fl. slow bin. [I have not seen it.]

P O 146. 0h 35m, S 5° 1′ : 6·5, 9 : 289°·9 : 57″·9, 1837 (Bu 65″.1, 1879) : yel., flushed bl.

26 (Σ **84** : 6·6, 9). 0h 58m, N 0° 44′; 6·5, 9·5 : 252°·6 : 16″·4 : pale topaz, lilac.

66 (Σ **231** : 6, 7·8). 11h 7m, S 2° 57′ : 7 (Gore 6, 1874), 8·5 : 229°·6 : 15″·4 : pale yel., sapph. bl. Rapid c. p. m. 1½° *p* Mira, a little *n*. Wa 2 small pairs near, *f* and *n*.

P O 113 (Σ **39** : 6·8, 8·5). 0h 28m, S 5° 13′ : 7, 9 : 44°·6 : 19″·6 : yelsh., fine bl. [9 over-rated? 1850.] Se has split 7.

61. 1h 58m, S 0° 55′ : 7 (Heis naked eye), 11 : 188°·8 : 39″ : pearly wh., 1834 [pale or., 1850], grnsh. [Attendant very obvious with averted eye.] B another *comes*, est. 13 : 330° : 55″ (Bu 326°·3 : 80″). Followed a little *s* by Σ **218**. 7, 8 : 250° : 4″·8 : wh., bl. [A little *p*, a pale ruby, with distant *comes* 11 mg. and *s p* a star 7 mg. with 2 small attendants.] 61 is 3° *s* a little *f* α Piscium.

[CETUS]

Σ **295** (84). $11^h\ 35^m$, S 1° 13′ : 6, 9·2 : 334°·6 : 4″·9 : yel., ash. (Slow bin. and c. p. m.)

Σ **91.** $1^h\ 1^m$, S 2° 23′ : 6·7, 7·5 : 328°·8 : 3″·9 : yelsh., wh. (Fl bin. ?)

Σ **61.** $111^h\ 3^m$, N 7° 3′ : 7, 7 : 162°·6 : 81″ : wh.

Bu **110.** $1^h\ 14^m$, S 16° 26′ : 7, 8 : est. 25° : 1″·8 (H 2036.)

Σ **274.** $11^h\ 25^m$, N 0° 35′ : 7·2, 7·7 : 218°·2 : 13″·5 : v. wh.

Σ **150.** $1^h\ 37^m$, S 7° 42′ : 7·2, 7·8 : 195°·5 : 36″·2 : v. wh. [Beautiful.]

Σ **280.** $11^h\ 28^m$, S 6° 12′ : 7·5, 7·7 : 349°·8 : 3″·8 : yelsh.

Σ **330.** $11^h\ 51^m$, S 1° 3′ : 7·5, 9·5 : 191°·1 : 8″·8 : v. yel., blsh.

Σ **334.** $11^h\ 53^m$, N 6° 8′ : 7·7, 8·2 : 322°·8 : 1″·6 : wh.

Σ **367.** $111^h\ 8^m$, N 0° 19′ : 8, 8 : 101°·4 : 0″·95 : yelsh. wh. (Rapid bin.)

Σ **323.** $11^h\ 46^m$, N 5° 56′ : 8, 8 : 283°·2 : 2″·5 : v. wh.

Bu **494.** $0^h\ 41^m$, S 1° 54′ : 8, 8·2 : 170°·6 : 1″·4.

Σ **3046.** $XXIII^h\ 50^m$, S 10° 10′ : 8, 8·5 : 232°·2 : 2″·5 : yelsh. wh. (Slow bin. C. p. m.)

Σ **110.** $1^h\ 12^m$, S 12° 57′ : 8, 8·5 : 356°·8 : 7″·3 : v. wh.

Σ **266.** $11^h\ 19^m$, S 2° 39′ : 8·2, 8·7 : 268°·3 : 7″·4 : v. wh.

Σ **265.** $11^h\ 18^m$, S 2° 16′ : 8·2, 8·7 : 136°·6 : 12″ : wh.

Σ **86.** $0^h\ 59^m$, S 6° 5′ : 8·2, 8·7 : 171° : 12″·1 : wh.

Bu **528.** $111^h\ 2^m$, S 4° 3′ : 8·5, 8·5 : 197°·5 : 1″. In field with Σ **358.** 8·5, 11·3 : 349°·3 : 15″·2 : wh., o.

Σ **332.** $11^h\ 52^m$, S 0° 4′ : 8·5, 8·5 : 52°·9 : 12″·7 : wh.

Σ **171.** $1^h\ 43^m$, S 2° 0′ : 8·5, 8·5 : 157°·6 : 27″·9 : wh.

Σ **106.** $1^h\ 10^m$, S 7° 46′ : 8·6, 8·7 : 308°·6 : 4″·6 : o, o.

[CETUS]

Σ 313. $11^h\ 43^m$, N 8° 26′ : 8·7, 9 : 191° : 5″·4 : o, o.

Σ 276. $11^h\ 26^m$, N 5° 47′ : 8·8, 8·8 : 253°·3 : 2″·3 : o, o.

(58. $1^h\ 52^m$, S 2° 39′ : Bu 6·5, 14 : est. 15° : 3″·5 ; test for 6 in. Bu. De 7, 12 : 12°·8 : 2″·7. About 2° *s p* 61. P could not find 58.)

[χ. $1^h\ 44^m$, S 11° 17′ forms a fine pair with P I 182. 5, 7·5 : pale yel., blsh. Closely *s p* ζ.]

Red Star. H 647. $1^h\ 56^m$, N 7° 6′ : 10, 10–11 : deep blood red, very intense and remarkable, grn., H. Bu col. not very striking. Nearly 5° *n* of α Pisc.)

Vars. R. $11^h\ 20^m$, S 0° 43′ : 7·9, 8·7—below 12·8 : 167^d.
S. $0^h\ 18^m$, S 10° 0′ : 7, 8—below 10·7 : 323^d.
Increase quicker than decrease.

Es has given a list of suspected vars. in Cetus in *Eng. Mech.* Jan. 17, 1879.

Nebulæ.

600 (M 77). $11^h\ 37^m$, S 0° 31′. 1° *f* δ, a little *s*. Small, faintish; very near 9 m^s. star. H thought it at least 910 times more distant than 1 m^s. stars! But qu. these inferences now? E. of Rosse spiral, bl.

342 (H I 100) $1^h\ 25^m$, S 7° 29′. Round, bright centre. E. of Rosse and d'A another fainter *s f*. [Neither found.]

CLYPEUS (*or SCUTUM*) *SOBIESKII.*

This asterism, which worthily associates the memory of the Polish hero with the most brilliant part of the Galaxy visible in our latitudes, is full of splendid telescopic fields: and the very ground of the Milky Way seems here resolvable.

[CLYPEUS (OR SCUTUM) SOBIESKII]

Σ **2325.** XVIII^h 25^m, S 10° 52′ : 6, 9·3 : 257°·9 : 12″·3 : wh., o.

Σ **2391.** XVIII^h 42^m, S 6° 8′ : 6·*z*, 9 : 332°·6 : 37″·9 : yelsh. wh., o.

Σ **2303.** XVIII^h 14^m, S 8° 1′ : 6·7, 9·2 : 216°·4 : 3″·2 : yelsh., o. (Moving.)

Σ **2373.** XVIII^h 39^m, S 10° 37′ : 7·1, 8·1 : 339°·1 : 4″·2 : wh., ashy.

Σ **2306.** XVIII^h 15^m, S 15° 9′ : 7·2, 7·9 : 219°·5 : 12″·8 : yel., v. bl. (Triple; Mitchel having split 7·9, which is opening; Cincinn. 65°·1 : 1″·3, 1879.) [The pair beautiful.]

Σ **2313.** XVIII^h 18^m, S 6° 40′ : 7·2, 8·5 : 199° : 6″·1 : yelsh. wh., ash.

Σ **2337.** XVIII^h 28^m, S 14° 48′ : 7·8, 8·8 : 297°·4 : 16″·4 : wh., blsh.

Var. R. XVIII^h 41^m, S 5° 51′ : 4·7, 5·7 – 6, 8·5 : 71^d, fluctuating : red.)

Clusters and Nebula.

4397 (M 24). XVIII^h 11^m, S 18° 27′. Magnificent region, visible to the unaided eye as a kind of protuberance of the Galaxy; and so considered by H, who gives stars 15 m^g. It is accompanied by two little pairs. 2° *n* of μ Sagittarii.

4400 (M 16). XVIII^h 12^m, S 13° 50′. Grand cluster.

4401 (M 18). XVIII^h 13^m, S 17° 12′. Glorious field in very rich vicinity. *s* lies a region of surpassing splendour.

4432 (M 26). XVIII^h 39^m, S 9° 31′. Coarse cluster.

4403 (M 17). XVIII^h 14^m, S 16° 15′. The 'horse-shoe' neb. visible in finder, 1° *n* of M 18, described by Sm as 'a magnificent, arched, and irresolvable nebulosity,—in a splendid group of stars.' Well has he observed, 'the wonderful quantity of suns profusely scattered about here would be confound-

[CLYPEUS (OR SCUTUM) SOBIESKII]

ing, but for their increasing our reverence of the Omnipotent Creator, by revealing to us the immensity of the creation.' The neb., however, Huggins finds to be gaseous; and Holden traces some changes of position with regard to neighbouring stars.

[4441 (H I 47). XVIII^h 47^m, S 8° 51′. Beautiful resolvable neb.]

COMA BERENICES.

A gathering of stars, which obviously requires distance only to become a nebula to the naked eye. Sweeping poor, except nebulæ.

Double Stars.

12. XII^h 16^m, N 26° 31′: 5, 8: 168°·2: 66″·1: straw-yel., rose-red; K 8 grey lilac, 1872; Fr lilac, 1877; [pale bl., 9 in. spec. 1872.] 1½° *s p* 16, the 'lucida' of the constellation. [The latter beautifully placed in little triangle of 8 or 9 m^g. stars; curious row of 4 stars *p*.]

35 (Σ **1687**: 5, 7·8, 9). Triple. XII^h 47^m, N 21° 54′: 5 (not given; K 7·5, 1872), 10: 42°, 126°·5: 1″·5, 28″·8, 1843 (K 52°·9: 1″·3, 1865; De 60°·9: 1″·3, 1877): pale yel., lilac, full bl. Bin. [Not well examined.]

24 (Σ **1657**: 4,7, 6·2). XII^h 29^m, N 19° 2′: 5·5, 7: 272°·1: 20″·5: or., lilac [striking and beautiful contrast, 1872].

2 (Σ **1596**: 6, 7·5). XI^h 58^m, N 22° 8′: 6, 7·5: 239°·9: 3″·6: pearly wh., lilac, 1839 (Ferrari 7·5 yelsh., 1874).

P XII 202, 201 (Σ **1685**: 6·8, 7·3). XII^h 46^m, N 19° 50′: 7·5, 8: 201°·9: 16″·2: wh. Heis visible to naked eye. 2° *s* of 35.

[COMA BERENICES]

Σ **21**[1] (17 and P XII 96). XII^h 23^m, N 26° 34′ : 4·8, 6 : 250°·7 : 145″·4 : wh., blsh. wh. [Fine pair.]

Σ **23**[1] (32, 33). XII^h 46^m, N 17° 44′ : 5·3, 6·1 : 48°·8 : 194″·8 : yel., wh.

Σ **1678**. XII^h 40^m, N 15° 1′ : 6·3, 7 : 211°·6 : 32″·6 : v. wh., yelsh. wh. (Moving.)

Σ **1639** (68). XII^h 18^m, N 26° 14′ : 6·7, 7·9 : 290° : 1″·2 : wh., ashy wh. (Bin.?)

Σ **1633**. XII^h 15^m, N 27° 42′ : 7·1, 7·2 : 245°·1 : 8″·7 : v. wh. [Very pretty : solitary.]

OΣ **266**. XIII^h 23^m, N 16° 20′ : 7·3, 7·8 : 324°·3 : 1″·2 : wh. (Moving.)

Σ **1699**. XII^h 53^m, N 28° 10′ : 7·8, 7·8 : 1°·2 : 1″·5 : o, o.

Σ **1722**. XIII^h 2^m, N 16° 8′ : 7·8, 8·8 : 343°·9 : 3″·5 : yelsh., blsh. (Fl bin.?)

Σ **1760**. XIII^h 29^m, N 26° 53′ : 8, 8 : 65° : 8″·5 : wh.

Σ **1696**. XII^h 52^m, N 31° 2′ : 8, 8·2 : 202°·5 : 3″·6 : v. wh.

Σ **1643**. XII^h 21^m, N 27° 42′ : 8·4, 8·7 : 71°·2 : 1″·9 : wh. (Bin.)

Σ **1756**. XIII^h 28^m, N 23° 37′ : 8·5, 9 : 176°·8 : 14″·2 : wh.

Σ **1652**. XII^h 27^m, N 21° 47′ : 9, 9 : 181°·9 : 6″ : o, o.

Var. R. XI^h 58^m, N 19° 27′ : 7·4, 8 — below 13 : 363^d : red.

Clusters and Nebulæ.

3453 (M 53). XIII^h 7^m, N 18° 47′. Brilliant mass of minute stars (H 11 — 15 m^g.), blazing in centre. H curved appendages. [Not very bright, $3\frac{7}{10}$ in. — beautiful, 9 in. spec.]

3321 (M 64). XII^h 51^m, N 22° 20′. Magnificent large

[COMA BERENICES]

bright neb. blazing to a nucleus. H resolvable, nucleus probably double star, with vacuity below it. [rather faint, $3\frac{7}{10}$ in.]

3106 (HJ V 24). XII^h 30^m, N 26° 39′. Long streak with parallel patch on *f* edge; 'extraordinary phenomenon.' E. of Rosse about 15′, nucleus projecting into dark 'lane,' sky *p* neb. darker than elsewhere. [Very faint, $3\frac{7}{10}$ in.; well seen, 9 in. spec.]

(2752 (HJ I 19). XII^h 4^m, N 19° 13′. Globular cluster, H.)

[2946 (M. 85). XII^h 19^m, N 18° 52′. Fair specimen of the many nebulæ in this region: midway from 24 towards 11, the nearest conspicuous star *p*, a little *s*.] d'A fainter neb. *f*.

(3101 (HJ I 92). XII^h 30^m, N 28° 37′. H club-shaped.)

(3249 (HJ I 84). XII^h 45^m, N 26° 9′. Star-like nucl. E. of Rosse incomplete oval ring round it.)

(2851 (HJ I 75). XII^h 14^m, N 30° 17′. Oblong: nucleus.)

(2855 (HJ I 90). XII^h 14^m, N 29° 57′. Nucleus like star 10 m^g. *s f* the last: a faint neb. *n f* this.)

[3043 (HJ I 83). XII^h 25^m, N 26° 26′. Near star 6 m^g.]

(2836 (HJ I 89). XII^h 12^m, N 28° 50′. Lengthened.)

CORONA BOREALIS.

A constellation resembling more than usual the object whose name it bears.

Double Stars.

ζ (Σ **1965**: 4·1, 5). XV^h 35^m, N 37° 2′: 5, 6: 301°·2: 6″·1: blsh. wh., smalt bl. 1842; flushed wh., blsh. grn., 1850.

ν^2 (Σ 29 App. I: 4·8, 5·1). XVI^h 18^m, N 33° 59′: 5, 12 [10, 1850, 1855]: 17°·9: 137″: pale yel., 1838 [deep yel., 1855; so Fr 1876], garnet, forms a fine group with ν^1, 5 m^g. deep yel., and a 6 m^g. grey star *f*. 5½ in. show HJ's minute *comes* to ν^1.

[CORONA BOREALIS]

η (Σ **1937** : 5·2, 5·7). XV^h 18^m, N 30° 43′ : 6, 6·5 : 57°·2 : 0″·8, 1832; 188°·5 : elong. 1846 (D 27°·5 : 1″·1, 1865; K 45°·8 : 1″, 1871; De 81°·2 : 0″·8, 1877; [split, but difficult, 9½ in. spec. 1878;] Bu 0″·46, 1880) : wh., gold. yel. One of Hl's severest tests, and one of the most rapid bin. systems. It is interesting to look at so wonderful an object as a pair of suns revolving in the brief period of 42 y. (Wijkander), even though our instrument cannot separate them; and they are at present evidently closing. C. p. m. Visible to naked eye, a little out of the curve of the coronet. Sm speaks of a glimpse-star, *nf.* Winnecke 26°·3 : 49″. Buffham 6·2 in. spec. Hunt glimpsed 4 in. achr.

σ (Σ **2032** : 5, 6·1). XVI^h 10^m, N 34° 10′ : 6, 6·5 : 107°·6 : 1″·3, 1830 (Se 192°·4 : 3″, 1865; K 194°·7 : 3″, 1867; 195°·3 : 3″·2, 1871; De 201° : 3″·4, 1877) : creamy wh., smalt bl., 1830–1843; but cols. questionable; P Sm 6 blsh., 1856; South 6·5 'certainly not bl.; it differs very little from the large star in col.,' 1825; Σ 6·5 wh., 1836; De 6, 6·5 : yel., yel. sometimes ashy, 1854–5; wh., ashy, 1856; Se 6·5 sometimes bl., sometimes yel., 1855–7; K v. pale yel., bl., 1871 [6·5 sometimes ruddy, sometimes blsh., 1850, 1855; $3\frac{7}{10}$ in. more than ½ m^g. diff. 1855; blsh., more than ½ m^g. 5½ in., 1862; so Fr 1879]; De 5·3, 6·5, 1854–5; Se m^{gs}. very discordant. Bin.; period very uncertain; extremes, Do 846 y., Jacob 195 y. Followed at 44″ (1839) by little bl. star, 11 m^g. Sm. 15 or 20 m^g. South, 1825, not visible with more than 92 of very fine 5 in. achr. [readily seen with 80, 144, 250 of $3\frac{7}{10}$ in. 1850; Fr more like 10 m^g., 1876]; De distance more than 51″, 1862, from c. p. m. of pair. H still minuter *comes*, 13 : Hall 221°·7 : 15″·9, 1876.

[CORONA BOREALIS]

Σ **1932.** $15^h\ 13^m$, N 27° 16′ : 5·6, 6·1 (vars.) : 273°·8 : 1″·6 : v. wh., 1830. (Du 299°·3 : 0″·96, 1875.)

Σ **1950.** $15^h\ 25^m$, N 25° 56′ : 6·7, 8·2 : 93°·2 : 3″·2 : gold, bl.

Σ **1964.** $15^h\ 34^m$, N 36° 37′ : 6·8, 7·3 : 86°·1 : 15″·4 : yelsh. [a little *s p* ζ. 6·8 var. ?]

Σ **1963.** $15^h\ 33^m$, N 30° 30′ : 7·3, 7·7 : 291°·2 : 4″·2 : wh. (B small pair near.)

Σ **1973.** $15^h\ 42^m$, N 36° 51′ : 7·3, 8·5 : 323°·4 : 30″·6 : wh.

Σ **2029.** $16^h\ 9^m$, N 29° 2′ : 7·5, 9·3 : 187°·6 : 6″·3 : wh., o.

Σ **1935.** $15^h\ 15^m$, N 31° 9′ : 8·5, 8·7 : 290°·2 : 8″·4 : wh.

Σ **1936.** $15^h\ 18^m$, N 27° 31′ : 8·5, 9 : 231°·9 : 20″·3 : wh.

Σ **1941.** $15^h\ 21^m$, N 27° 3′ : 8·7, 8·7 : 232°·7 : 1″·6 : wh.

T. $15^h\ 54^m$, N 26° 16′. The 'Blaze star' with a double spectrum, from the addition of the bright lines of hydrogen; discovered by B, 2 m^g., 1866, May 12; 8·5 m^g., May 24; afterwards to 9 m^g.; reviving to 7 and 7·5 m^g., Aug. 20; Oct. 5. This marvellous object should be carefully watched, especially as it had previously shown signs of unsteadiness. Backhouse found it still irregularly decreasing, 1872. H gave it 6·3 m^g., 1842. A, 9·5 m^g., 1855.—$\frac{1}{3}$ from ε Cor. towards π Serp. Baxendell at one time buff, with a tinge of bl. over it. See o^2 Cyg.

Vars. R. $15^h\ 44^m$, N 28° 32′ : 5·8—13 : irregular : red.
S. $15^h\ 17^m$, N 31° 48′ : 6·1, 7·8—11·9, 12·5 : 361^d.
U. $15^h\ 13^m$, N 32° 5′ : 7·6—8·8 : $3^d\ 10{\cdot}8^h$.

CORVUS.

This small constellation contains several conspicuous stars.

[CORVUS]

Double Stars.

β. XII^h 28^m, S 22° 44′: ruddy yel., 1831 [pale yel., 1852]. The companions in the Bedford Catalogue are distant: but it is inserted to be watched for variation. Sm found, 1831, that though possessing no Arabic name, and lettered β by Bayer, it was unquestionably the brightest in the constellation. HJ, 1783, gave the order $\gamma\ \delta\ \beta\ \alpha$; 1796, $\gamma\ \beta\ \delta\ \alpha$, with but little diff. between them; I found them, 1852, 1854, 1859, 1861, $\gamma\ \delta\ \beta\ \alpha$; Fr, 1878, $\gamma\ \delta\ \beta\ \epsilon\ \alpha$.[1]

δ. XII^h 24^m, S 15° 51′: 3, 8·5: 210°·9: 24″: light yel., purp.

Σ 1669. XII^h 35^m, S 12° 21′: 6·5, 6·5: 298°·9: 5″·4: yelsh. wh. Sa *comes* 10·5 m^g.

Bu 28 (P XII 104). XII^h 24^m, S 12° 43′: 6·5, 12: est. 355°: 3″. Very beautiful.

Σ 1664. XII^h 32^m, S 10° 50′: 7·7, 8·8: 271°·6: 17″·1: yel., bl., 1830. (Cincinn. 249°·7: 21″·1, 1878.)

Var. R. XII^h 13^m, S 18° 35′: 6·8, 7·3—below 11·5: 318^d: red.

Nebula.

2917 (HJ I 65). XII^h 18^m, S 18° 7′. HJ resolvable. Nucleus.

[1] Gould, in his admirable 'Uranometria Argentina,' considers that $\beta\ \gamma\ \delta$ and ϵ are all subject to change; and expresses his firm conviction that a very large proportion of the fixed stars, probably at least one-half above 7 m^g. (the limit of naked-eye visibility at Córdoba), fluctuate in brightness, to an extent which might be detected by such careful observations as his own.

CRATER.

Like Corvus, an appendage to Hydra.

Double Stars.

17. $11^h\ 26^m$, S 28° 36′ : 5·5, 7 : 207°·8 : 10″·1, 1833 (Morton 211°·4 : 8″·8, 1857) : lucid wh., viol.—7 var? H 6, 6, 1835; [only ½ mg. diff. 1852; so Morton 1857; Fr 1876 (who makes 5·5 decided yel.); Gore 7 larger than 5·5, 1875.] C. p. m.

P XI 39 (Σ **1530**: 7·8, 8·2). $11^h\ 14^m$, S 6° 14′ : 8·5, 9 : 315° : 8″ : blsh. wh. [A 10 mg. pair in field. About 45′ *p* is a fine pair, H & South 120, 7, 9 : wh., blsh. or lilac; moving. Bu 7 very minutely double.]

Σ **1509.** $11^h\ 1^m$, S 12° 46′ : 7·2, 9 : 15°·2 : 32″·9 : yel., o.

(β, see in Appendix III.)

Red Star. R. B 250. $x^h\ 55^m$, S 17° 41′ : 8 : H 'scarlet, almost blood-col.; a most intense and curious colour.' Closely *f* α, Baxendell var. [10 mg. 1874] Sa 8·5, 1876. A star 9 mg. (K 10, 1866) pale bl. *p*.

CYGNUS.

This fine cruciform constellation occupies a prominent position in the Galaxy, and its low-power fields are overpowering in magnificence. The principal star, Deneb, has no perceptible parallax or proper motion; so far deserving the title, usually very inappropriate, of a 'fixed star;' hence we must infer amazing distance, and magnitude surpassing possibly that of Arcturus, Wega, or even Sirius itself. Huggins believes that it is approaching us at about 39 miles per second.

[CYGNUS]

Double Stars.

β (Σ 43 App. I.: 3, 5·3). XIX^h 26^m, N 27° 42′ : 3, 7 (var.?) : 55°·6 : 34″·4 : gold. yel., smalt bl. One of the finest in the heavens. I have seen the colours beautifully by putting the stars out of focus. Sm observes that they are actually different, not, as may sometimes be the case, complementary, from mere contrast; an effect which is seen when the bright yellow light of a lamp makes the Moon appear blue, and which Schm witnessed to a remarkable degree at his observatory on Vesuvius during the great eruption of 1855, when the sky was as green as bottle-glass, and the Full Moon a lively green, through openings in red clouds of smoke and steam. A similar result may take place with some double stars, but not with all, as is proved by hiding the larger star behind a bar in the field. Hence artificial light is misleading in estimating star colours.

δ (Σ **2579** : 3, 7·9). XIX^h 41^m, N 44° 50′ : 3·5, 9 : 30°·9 : 1″·5, 1837 (K 348°·3 : 1″·7, 1866; De 330°·1 : 1″·6, 1877) : pale yel., sea-grn. (K fine bl.). 9 difficult with moderate apertures, because it falls on interference ring; often easy in twilight, but invisible in a dark sky;[1] has been thought var. Seen finely by Buffham with 6½ of 9 in. 'With' spec. and by Noble, 4⅛ in. achr. Hind period about 179 y., Behrmann 415 y. C. p. m. D pair 12′ *n* : 7·5, 11·25 : 266° : 2″·3. [± 6^m *f*, pretty pair not in Σ.]

o^2 (Σ 50 App. I. : 3·7, 5, 6·5). Triple. XX^h 10^m, N

[1] The celebrated observer Dr. Dunér, of Lund (Sweden), who uses a very fine 9$\frac{6}{10}$ in. Merz achr., says, 'Rarement j'ai observé l'étoile après le coucher du soleil. Ce qui a été dit de δ Cygni peut se dire, avec certaines modifications, aussi d'autres étoiles du même type.'

[CYGNUS]

46° 23′ : 4, 7·5 (P XX 63), 5·5 (o^1) : 174°·1, 323°·8 : 107″, 338″ : or., two bl., 1838. Sm found both the smaller stars cerul. bl. when the larger one was concealed; Σ also called them bl. 'insignes,' 1836. But I have noted 5·5 wh., $3\frac{7}{10}$in., 1850; wh. or yelsh., 'with an eye of bl.,' $5\frac{1}{2}$ in., 1865; 'pale yel. with a cast of bl., a strange but accurate description;' same cols. $9\frac{1}{3}$ in. silver, 1867, 1869; Sa same cols. (See T Cor.) There is a 16 m^g. 330° : 15″, 1838 (Bu 321°·7 : 36″·8, 1878); a light test. Fr holds it with 5 in. achr. Sa easy $6\frac{1}{2}$ in. spec.

μ. (Σ **2822** : 4, 5). Triple. XXI^h 39^m, N 28° 12′ : 5, 6, 7·5 : 114°·3, 61°·2 : 5″·4, 216″·8, 1839 (Fl 56°·3 : 208″·5, 1878) : wh., two bl. : these cols. should be watched; observers differ. Fr several minute stars with 5 in. achr. between 7·5 and close pair. So Fl. Σ finds c. p. m. in the close pair. Bin.?

χ (F, P. Sm.) (Σ **2580** : 5·1, 8·1). XIX^h 42^m, N 33° 27′ : 5, 9 : 72°·9 : 25″·7 : gold. yel., pale bl. Relatively fixed, c. p. m. Beautiful field. About 4^m *f*, 50′ *s* is 17, or χ Bayer, discovered by Kirch, 1686, to be var., sometimes up to 5 m^g.; period about 406^d, splendidly red, but suspected of losing colour as it gains light; many of the same class have this hue. It is *not*, as Sm states after Piazzi, P XIX 295, which lies between the other two stars. Stone proposes to call the pair χ^1, the var. χ^2.

ω^3. XX^h 28^m, N 48° 49′ : 5, 10 : 318°·9 : 55″ : pale red, grey. P XX 199 : 7, 9·5 : 61″ : wh., pale bl. (Sa bl., mauve) *p* makes with it a fine group. Two stars, which my $3\frac{7}{10}$ in. would just reach, but which are said to have been seen with 3 in., form a trapezium with ω^3.

61 (Σ **2758** : 5·3, 5·9). XXI^h 1^m, N 38° 9′ : 5·5, 6 : 96°·3 : 16″·3, 1839 (K 111°·7 : 18″·8, 1866; Do 116°·7 :

[CYGNUS]

19″·5, 1877) : yel., deeper yel. (Closely *s* of 61 is a purple star 10·5 m^g.) One of the most interesting objects in the sky.[1] These suns were the first of the host of heaven to reveal to Bessel (1838) the secret of their distance. This is probably 366,400 times that of the Earth from the Sun—itself 92,400,000 miles—a space so vast, that light, which reaches us from the Sun in 8^m, employs nearly 6 years to traverse it: we see these stars, therefore, not as they are now—for of their present existence we have no information—but as they were 6 years ago.[2]

How vast must be the dimensions of this great Universe! What a temple for the Creator's glory! 'All the whole heavens are the LORD'S'—those heavens are crowded with millions upon millions of stars; and of all that countless multitude, millions, probably, for one, are at a distance incalculably exceeding that of 61 Cygni!

ψ (Σ **2605** : 5, 7·5). XIX^h 53^m, N 52° 7′ : 5·5, 8 : 184°·2 : 3″·5 : bright wh. (Fr grnsh. wh., 1876), lilac.

[1] The binary character ascribed to them has been doubted, and the change referred to a very large proper motion, but it probably exists. Bessel's grand result was obtained with the Königsberg Heliometer. The instrument absurdly so termed, as if it were intended to measure the *Sun*, has an object-glass cut into two halves: a slight displacement of these by producing a double image affords the means of accurate measurement. There is a fine heliometer at Oxford, 7½ in. aperture.

[2] From the successive transmission of light results the extraordinary fact that the aspect of the whole heavens is of unequal date, each star having its own time of 'light-passage' to our eyes, and those times immensely differing, so that there is no impossibility in Humboldt's magnificent assertion, 'much has long ceased to exist before the knowledge of its presence reaches us; much has been otherwise arranged.' As Huggins remarks, the outburst of T Coronæ may have occurred many years ago.

[CYGNUS]

52 (Σ **2726** : 4, 9·2). $xx^h\ 41^m$, N 30° 17′ : 5·5, 9·5 : 56°·9 : 7″ : or., bl. 3° *s* of *ε*. $4^m\ 55^s$ *f*, 10′ *n* of 52 is Ll 40318. 7, 11·5 : est. 290° : 1¼″, Bu (De 6·9, 10·2 : 287°·1 : 1″·5, 1875.)

P XX 429 (Σ **2741** : 6, 7·3). $xx^h\ 55^m$, N 50° 0′ : 6, 7·5 : 34°·6 : 2″·1 : silvery wh., pale grey. Fl bin.

P XIX 278. $xix^h\ 41^m$, N 34° 43′ : 6, 8 : 28°·8 : 39″ : straw col. (Fr deep yel., 1876), smalt bl. [Beautiful.] 1¼° *n* of *χ*.

49 (Σ **2716** : 6, 8·1). $xx^h\ 36^m$, N 31° 53′ : 6, 9 : 48°·8 : 3″·2 : golden yel., bl. 2° *s p ε*.

16 (Σ 46 App. I : 5·1, 5·3). $xix^h\ 39^m$, N 50° 15′ : 6·5, 7, 1834 [not much diff. 1850–1 ; nearly equal, 9 in. spec. 1871; so Fr 1876] : 136°·4 : 37″·3 : pale fawn col. Fr some diff. 1876. Σ c. p. m. Within 1° *n f θ*.

P XXI 1 (Σ **2762** : 6, 8). $xxi^h\ 4^m$, N 29° 43′ : 6·5, 9 : 316°·5, 1833 (Gl 313°, 1874) : 3″·5 : dull wh., pale lilac. Fr 2 *comites*, 35″, 40″, one only mentioned by Sm.— 1½° *p ζ*.

P XX 452 (Σ **2748** rej.). xx^h 58′, N 39° 2′ : 7, 11 : 297° : 17″ : deep yel., emerald [11 obvious, 1850, some hours past meridian.] 13 m^g. star *s f*. Wa several *comites*.

P XIX 276 (Σ **2578** : 6·6, 7·4). $xix^h\ 41^m$, N 35° 48′ : 8, 8·5 (De vars.) : 126°·5 : 15″ : wh. Wa several minute *comites*.

P XIX 149 (Σ **2534** : 7·8, 8). $xix^h\ 23^m$, N 36° 17′ : 8·5, 9 : 61°·9 : 7″ : wh., pale bl. Fine field : closely *f* 4, a 5 m^g. star.

P XIX 169 (Σ **2539** : 7·9, 9·7). $xix^h\ 27^m$, N 28° 1′ : 9, 11 : 5° 2 : 5″·8 : wh., pale bl.

[CYGNUS]

Σ 2743. xx^h 56^m, N 47° 3′ : 4·7, 9 : 352°·4 : 20″·2 : grnsh. wh., bl.

OΣ 413 (λ). xx^h 43^m, N 36° 4′ : 5, 6·3 : 82°·1 : 0″·7 : wh., o. Rapid bin.

Σ 2486. xix^h 9^m, N 49° 37′ : 6, 6·5 : 224°·8 : 10″·5 : yel., 1832. [equal, 9 in. spec. 1871; so Fr 1876.] Moving, and c. p. m. [Singular and beautiful field.]

Σ 55[1]. xxi^h 19^m, N 36° 51′ : 6, 6·6 : 302°·5 : 365″·4 : yel., wh.

Σ 2671. xx^h 15^m, N 55° 1′ : 6, 7·4 : 341°·1 : 3″ : wh., ash (Fr tawny, 1876). [A pretty pair.]

OΣ 437. xxi^h 16^m, N 31° 56′ : 6·5, 7·2 : 57°·8 : 1″·5 : yel., o.—Moving.

Σ 2700. xx^h 30^m, N 32° 5′ : 6·5, 8·3 : 286°·2 : 24″ : yel., v. bl. [2 wide pairs *f.*]

Σ 2666. xx^h 14^m, N 40° 21′ : 6·5, 8·7 : 242° : 2″·7 : v. wh., blsh. (Fl bin. ?)

Σ 2732. xx^h 45^m, N 51° 28′ : 6·7, 8·7 : 73°·8 : 4″ : wh., o.

OΣ 432 (P XXI 50). xxi^h 10^m, N 40° 40′ : 6·8, 7·2 : 130°·4 : 1″·2 : gold.

OΣ 389. xix^h 47^m, N 30° 49′ : 6·9, 8·8 : 183° : 12″·8.

OΣ 384 (P XIX 263). xix^h 30^m, N 38° 2′ : 7, 7·3 : 195°·9 : 1″.

OΣ 447. xxi^h 34^m, N 41° 10′ : 7, 7·9 : 45°·3 : 29″ : yel., yelsh.—Triple; 11·1 : 169°·4 : 14″.—2 still smaller.

Σ 2609. xix^h 54^m, N 37° 47′ : 7, 8·1 : 29°·1 : 2″·4 : v. wh.

Σ 2708. xx^h 34^m, N 38° 13′ : 7, 8·7 : 351°·7 : 11″·3 : yel., bl., 1832. (Fr scarcely 1 m^s. diff. 1876 [8, 9, 1879]; Do 333°·6 : 21″·8, 1877. Moving.)

[CYGNUS]

Σ **2658.** xx^h 10^m, N 52° 44′ : 7, 9·1 : 126°·9 : 5″·5 : yelsh. wh., bl.—Triple; 10·2 : 216°·8 : 32″·1.

Σ **2668.** xx^h 16^m, N 39° 2′ : 7, 9·2 : 293°·6 : 3″·3 : yelsh. wh., ash. (Fl bin.?)

Σ **2789.** xxi^h 16^m, N 52° 28′ : 7·1, 7·1 : 116°·4 : 5″·9 : wh., yelsh.

Σ **2707.** xx^h 34^m, N 47° 33′ : 7·1, 7·9 : 196° : 55″·4 : wh.—Triple; 8·6 : 31°·7 : 23″ : wh.

Σ **2705.** xx^h 33^m, N 32° 55′ : 7·1, 8·1 : 262°·1 : 3″ : yel., bl.

Σ **2479.** xix^h 6^m, N 55° 7′ : 7·1, 9·4 : 38° : 6″·7 : wh., bl.

Σ **2624.** xix^h 59^m, N 35° 42′ : 7·2, 7·8 : 178°·8 : 2″ : wh.—Triple; 9·5 : 327°·4 : 42″·4.

OΣ **414.** xx^h 43^m, N 41° 59′ : 7·2, 8·3 : 95°·9 : 9″·9.

Σ **2607.** xix^h 54^m, N 41° 57′ : 7·2 (Heis 6), 9 : 293°·4 : 3″·2 : wh., ash, 1831. [or., bl., 9 in. spec. 1871; so Fr 1876.] (OΣ 7·2 extremely close pair.)

OΣ′**418.** xx^h 50^m, N 32° 15′ : 7·3, 7·4 : 293° : 1″ : redsh. wh.—Moving.

Σ **2760.** xxi^h 2^m, N 33° 38′ : 7·3, 8·1 : 223°·3 : 13″·3 : yelsh. wh., ashy. (Moving.)

Σ **2525.** xix^h 22^m, N 27° 8′ : 7·4, 7·6 : 255°·9 : 1″·3 : yelsh. (Moving.)

Σ **2803.** xxi^h 26^m, N 52° 25′ : 7·4, 9 : 290°·2 : 23″·2 : v. wh., o.

Σ **2606.** xix^h 54^m, N 32° 57′ : 7·5, 8·2 : 131° : 1″·2 : yelsh. wh.

OΣ **393.** xix^h 54^m, N 44° 4′ : 7·5, 8·4 : 227°·4 : 21″·2 : redsh., bl.—Moving?

Σ **2522.** xix^h 21^m, N 28° 32′ : 7·5, 9 : 339°·2 : 4″·4 : wh., o.

[CYGNUS]

OΣ 431. $21^h\ 7^m$, N 40° 45′ : 7·6, 8 : 117°·3 : 3″·2.

OΣ 386. $19^h\ 44^m$, N 36° 51′ : 7·7, 8 : 77°·5 : 1″.

Σ 2639. $20^h\ 4^m$, N 35° 7′ : 7·7, 8·7 : 303°·5 : 5″·6 : elsh. wh., ashy wh. [Beautiful.]

Σ 2649. $20^h\ 7^m$, N 31° 44′ : 7·7, 8·8 : 152°·3 : 26″·1 : elsh. wh., ashy.

Σ 2576. $19^h\ 41^m$, N 33° 20′ : 7·8, 7·8 : 318°·8 : 3″·6 : el. (Fl bin.)

OΣ 456. $21^h\ 51^m$, N 51° 57′ : 7·8, 8 : 25°·7 : 1″·3.

OΣ 416. $20^h\ 48^m$, N 43° 19′ : 7·8, 8·1 : 141°·3 : 7″·3.

Σ 2832. $21^h\ 45^m$, N 49° 58′ : 7·8, 8·3 : 213°·6 : 13″·1 : . wh.

Σ 2802. $21^h\ 27^m$, N 33° 17′ : 8, 8 : 11°·3 : 3″·8 : wh.

Σ 2611. $19^h\ 55^m$, N 47° 2′ : 8, 8 : 26°·4 : 5″·1 : elsh. wh.

Σ 2626. $20^h\ 0^m$, N 30° 12′ : 8, 8·2 : 121°·7 : 1″·2 : wh. (Fl bin. ?)

Σ 2691. $20^h\ 25^m$, N 37° 44′ : 8, 8·2 : 32°·8 : 17″·1 : wh. [A fine pair.]

Σ 2645. $20^h\ 6^m$, N 51° 20′ : 8, 8·3 : 136°·9 : 1″·5 : . wh.

Σ 2663. $20^h\ 12^m$, N 39° 19′ : 8, 8·5 : 324°·9 : 5″·3 : wh.

Σ 2711. $20^h\ 35^m$, N 30° 4′ : 8, 9 : 222°·5 : 2″·5 : wh.

Σ 2693. $20^h\ 25^m$, N 54° 6′ : 8, 9 : 183°·7 : 13″·6 : wh.

Σ 2619. $19^h\ 57^m$, N 47° 57′ : 8·1, 8·1 : 244°·9 : 4″·3 : elsh. wh. (H *comes* 12 m^g.—OΣ another.)

Σ 2610. $19^h\ 54^m$, N 35° 11′ : 8·1, 8·6 : 298°·4 : 4″·3 : wh.

Σ 2747. $20^h\ 58^m$, N 37° 10′ : 8·2, 8·2 : 257°·4 : 4″·5 : wh. ($3^m\ 34^s$ *p*, 55′ *s* from 61. Exceedingly pretty.)

Σ 2538. $19^h\ 27^m$, N 36° 28′ : 8·2, 8·3 : 245°·3 : 53″ : wh.—Triple; 8·7 : 52°·6 : 6″·1 : wh.

[CYGNUS]

Σ **2667.** $xx^h\ 14^m$, N 45° 15′ : 8·2, 8·5 : 225°·7 : 8″·1 : v. wh.

Σ **2542.** $xix^h\ 29^m$, N 52° 43′ : 8·2, 8·7 : 254°·1 : 11″·3 : wh.

Σ **2773.** $xxi^h\ 6^m$, N 43° 31′ : 8·2, 9 : 118°·4 : 3″·3 : v. wh.

Σ **2507.** $xix^h\ 16^m$, N 44° 10′ : 8·2, 9·3 : 136°·7 : 23″·9 : wh., o.

Σ **2524.** $xix^h\ 22^m$, N 25° 17′ : 8·3, 8·5 : 104°·6 : 7″·2 : wh.

Σ **2779.** $xxi^h\ 9^m$, N 28° 36′ : 8·5, 8·5 : 189°·4 : 19″·2 : yelsh. (Moving.)

Σ **2702.** $xx^h\ 31^m$, N 34° 45′ : 8·5, 8·7 : 205°·8 : 3″·3 : wh.

Bu **434.** $xx^h\ 28^m$, N 41° 27′ : 8·5, 9 : est. 100° : 1″·2.

Bu **430**, Triple. $xx^h\ 7^m$, N 35° 28′ : De 9·5, 10, 9·7 : 17°·7, 51°·3 : 1″·1, 16″·9 ; 1876.

Σ **2852.** $xxi^h\ 56^m$, N 53° 35′ : 9, 9 : 171°·9 : 7″·7 : wh.

(r. $xxi^h\ 10^m$, N 37° 32′ : Bu 4·8, 7·6 : 150° : 1″ : pale yel., pale bl. 1878. Rapid bin. Discovered by A. Clark, jun., 26 in. McCormick achr. Holden *comes*, 260°·3 : 15″·7.)

[Pair, Hh **640.** $xix^h\ 42^m$, N 32° 47′ : 6·5, 9 (A) : yel., bl.]

[Pair, H 1470. $xix^h\ 59^m$, N 38° 0′ : ruddy yel., contrasted grn. : Se 7, 8 (A 7·2, 9·4; B 8, 10) : 335°·2 : 23″·8 : pale clear red, intense bl. '*colori superbi.*']

(Pair, B. $xix^h\ 25^m$, N 28° 27′ : 7·5, 12 : est. 90° : 40″ : red, intense bl.)

[48, P XX 243. $xx^h\ 33^m$, N 31° 8′ : 8, 8·25 : wh. (Σ 6, 6·1 : 174°·8 : 178″·1). In splendid region. 20′ and 30′ *n* of 48 are two similar but smaller pairs. The student will meet with many inexplicable arrangements of this character in crowded fields.]

[Two Pairs and Triplet, ± $xix^h\ 29^m$, N 28° 20′.]

[CYGNUS]

[Triplet, ± xx^h 29^m, N 29° 15′.]

Red Stars. [B 587. xxi^h 32^m, N 44° 50′ : 6·7. Webb.]
[B 592. xxi^h 38^m, N 37° 28′ : 7·8. Bessel.]
B 509. xix^h 36^m, N 32° 21′ : 8. B.
[B 521. xix^h 53^m, N 43° 56′ : 8·2. Webb.]
[B 541. xx^h 9^m, N 38° 22′ : 8·2. Webb.]
[B 598. xxi^h 51^m, N 49° 57′ : 9·1. H. mag. and col. var.]
B 582. xxi^h 18^m, N 41° 53′ : 9·5. La.
[B 554. xx^h 17^m, N 36° 32′ : 9·5. Webb.]
B 553. U, see Vars.
B. A. C. 7001. xx^h 15^m, N 38° 38′ : 7 var? Fr.
B. A. C. 7219. xx^h 44^m, N 45° 8′ : 7 var? or. red. Fr.

[ρ. xxi^h 30^m, 45° 4′ : 4·5, has an or. ruby 7 m^g. *ef*, beyond a fine sprinkle of small stars.]

[Quadruple. ± xx^h 4^m, N 36° 20′ : 7 : wh., 10 : red, 11, 11·5 : bl. A very pretty object.]

Vars. P. xx^h 13^m, N 37° 39′ : formerly 3·5—below 6 ; 5 since 1677.
R. xix^h 34^m, N 49° 56′ : 5·9, 8—13 : 425^d : red. Pogson. *ef* θ, in field.
S. xx^h 3^m, N 57° 38′ : 8·8, 9·5—below 13 : 322^d.
T. xx^h 42^m, N 33° 56′ : 5·5?—6? : 365^d?
[U. xx^h 16^m, N 47° 31′ : B. (K 7·8?—9·8?) Beautiful red, with bl. *comes*.]

Schm's *Nova*, xxi^h 37^m, N 42° 16′, appeared suddenly 3 m^g., 1876, Nov. 24, and has faded to 10·5 m^g., while the spectrum has marvellously changed from the bright lines of incandescence to the monochromatism of a gaseous neb.—Wa 14 m^g. 1878, Oct.

Clusters.

4681 (M 39). $xxi^h\ 28^m$, N 47° 54′. Brilliant group and vicinity.

[4575 (H VIII 56). $xx^h\ 19^m$, N 40° 20′. Beautiful group, H 10–12 m^g. ½° *n* of *γ*, a little *f*.]

[4544 (H VII 59). $xx^h\ 0^m$, N 43° 40′. Fine cl.]

[4591 (H VII 8). $xx^h\ 29^m$, N 27° 54′. Field of minute stars.]

[*γ*. $xx^h\ 18^m$, N 39° 52′, 3 m^g., has a brilliant field *f*, and splendid sweeping *s*, especially between 36° and 37°, in the neighbourhood of 28, 29, 36, all 5 m^g.]

[Glorious sweeping along 35° 30′, culminating about 27. $xx^h\ 2^m$, N 35° 39′.] Fr fine trapezium ¼° *s* of 27, brightest beautiful double.

[*η*. $xix^h\ 52^m$, N 34° 46′ : 5 m^g. var. ? has a curious trapezium 10^m *f*.]

[32. $xx^h\ 12^m$, N 47° 21′ : 5 : dull or. marks a fine field.]

I had at one time projected a survey of the wonders of this region with a sweeping power; but want of leisure, an unsuitable mounting, and the astonishing profusion of magnificence combined to render a task hopeless for me which, I trust, may be carried through by some future observer.

DELPHINUS.

The leaders of this little, compact, fish-like constellation, *α* and *β*, are distinguished by names which, even among the multifarious disfigurements of Oriental words so abundant in the heavens, are pre-eminently strange, *Svalocin* and *Rotanev*. The former Sm has justly characterised as 'cacophonous and barbaric,' and says that 'no poring into the black-letter ver-

sions of the Almagest, El Battáni, Ibn Yúnis, and other authorities, enables one to form any rational conjecture as to the mis-reading, mis-writing, or mis-application, in which so strange a metamorphosis could have originated.' And of *Rotanev* he observes, 'the which putteth derivation and etymology at defiance.' Where so eminent and accomplished a scholar and antiquarian did not succeed, it would seem presumptuous to offer a solution, but that accident is sometimes more fortunate than study; and if the following is not after all the right key, it certainly is a marvel that it should open the lock so readily. The letters of these strange words, reversed, form NICOLAUS VENATOR, a Latin version of the name of NICCOLO CACCIATORE, assistant at the Palermo Observatory, in the Catalogue emanating from which these stars are so denominated.[1]—A very fine region for sweeping.

Double Stars.

γ (Σ **2727** : 4, 5). $xx^h\ 41^m$, N 15° 42′ : 4, 7 : *z*73°·3 : 11″·8 : yel., light emerald, 1831–1839; gold. yel., flushed grey, 1850. ΗΙ wh., 1779; hence Σ suspects change. H and South wh., yelsh., 1824. Gore redsh. yel., greysh. lilac, 1874. C. p. m.

P XX 178, 177 (F 15, Σ **2690** : 7·0, 7·2). $xx^h\ 26^m$, N 10° 51′ : 7·5, 8 : 256°·1 : 14″·3 : wh. [nearly equal, 1865, 1880; Fr equal, 1876]. A 9 m^g. which D discovered, 1840, as an elongation of 8, and a 16 m^g. 125° : 20″ (Bu 108°·5 : 23″·6, 1877), make up a most difficult quadruple group. Sm 16 by evanescent glimpses, 1835; Buffham steady, 6½ in. 'With' spec., 1868. Closely *sp* ε. 2^m *p*, 21′ *s*, is F 1 : Bu 6, 11 : De 342°·4 : 0″·86. Triple; Washington achr. est. 360° : 15″. One of the most difficult triples.

[1] Cacciatore died in 1841 from the effects of cholera.

[DELPHINUS]

(13. xx^h 41^m, N 5° 34′ : De 5·2, 8·9 : 186°·4 : 1″·6, 1875.)

[*a*, xx^h 34^m, N 15° 29′, and P XX 247 form a fine combination; pale yel., pale lilac.] Bu and Sa several minute *comites*.

[β, xx^h 32^m, N 14° 11′ (with 2 minute *comites*), and ζ, two fine yel. stars, have a beautiful little 8 m^g. triangle between them.] Bu β excessively close double, De moving.

[θ, xx^h 33^m, N 12° 54′, is in a beautiful field.]

Σ 2723. xx^h 39^m, N 11° 51′ : 6·4, 8·2 : 85°·6 : 1″·5 : wh. (Fl bin.?)

Σ 2665. xx^h 14^m, N 13° 59′ : 6·5, 9·2 : 17°·2 : 3″·1 : wh., o.

Σ 2738. xx^h 53^m, N 15° 58′ : 7·2, 8·2 : 254°·4 : 14″·7 : wh., o. (*s p* in field is B 573, pale red : 7·3 m^g. var.?)

Σ 2725. xx^h 41^m, N 15° 27′ : 7·3, 8 : 358° : 4″·2 : wh., ashy. (Fr yel., bl. 1876. Fl very slow bin.) [*s* a little *p* γ; very pretty.]

Σ 2718. xx^h 37^m, N 12° 17′ : 7·4, 7·6 : 86°·6 : 8″·3 : wh.

Σ 2736. xx^h 51^m, N 12° 30′ : 7·5, 8·7 : 218°·5 : 5″·1 : wh.

Σ 2703. xx^h 31^m, N 14° 19′ : 7·6, 7·6 : 291°·2 : 25″·1 : wh., yelsh.—Triple; 7·6 : 239°·4 : 66″·7 : wh.

Σ 2664. xx^h 14^m, N 12° 38′ : 7·7, 8·2 : 322°·6 : 27″·7 : wh.

Σ 2730. xx^h 45^m, N 5° 57′ : 7·8, 7·9 : 339°·2 : 3″·4 : yelsh. wh. [A pretty pair.]

Σ 2701. xx^h 31^m, N 11° 38′ : 7·8, 8·2 : 218°·8 : 2″·1 : yelsh., wh.

Σ 2696. xx^h 27^m, N 5° 4′ : 8, 8·4 : 298°·9 : 1″·1 : wh. (Fl bin.?)

[DELPHINUS]

Σ **2754.** $21^h\ 1^m$, N 12° 43′ : 8, 8·7 : 303°·2 : 34″·6 : wh.

Σ **2722.** $20^h\ 38^m$, N 19° 17′ : 8·2, 8·7 : 308° : 7″·1 : yelsh. wh., ash.

Σ **2734.** $20^h\ 48^m$, N 12° 38′ : 8·2, 8·7 : 181°·7 : 28″·5 : wh. (Moving.)

Σ **2680.** $20^h\ 19^m$, N 14° 29′ : 8·3, 8·5 : 289° : 15″·8 : wh.

Σ **2739.** $20^h\ 55^m$, N 19° 36′ : 8·3, 8·8 : 252°·1 : 3″·2 : wh.

Σ **2720.** $20^h\ 38^m$, N 16° 30′ : 8·5, 8·7 : 185° : 3″·8 : wh.

Σ **2713.** $20^h\ 35^m$, N 10° 8′ : 9, 9 : 64°·1 : 4″·8 : wh.

Vars. R. $20^h\ 9^m$, N 8° 44′ : 7·6, 8·5—12·8 : 284^d.

S. $20^h\ 38^m$, N 16° 39′ : 8·4, 8·6—10·4, 11·1 : 275^d.

T. $20^h\ 40^m$, N 15° 58′ : 8·2, 8·9—below 13 : 203^d : red.

Nebula.

4586 (H I 103). $20^h\ 28^m$, N 6° 59′. H bright, large, resolved, 16–20 m^g. d'A easy.

DRACO.

A long, winding constellation, always above the horizon; in consequence of which its stars, like all others in the Arctic Circle, appear at different times *entirely reversed* in relative position. A careful attention to *p* and *f*, that is, to the direction of apparent motion through the field, is in these cases required to ensure identification. Here are many fine pairs.

Double Stars.

μ (Σ **2130** : 5, 5·1). $17^h\ 3^m$, N 54° 38′ : 4, 4·5 (D 6, 6; Fl both var. ?) : 206°·7 : 3″·6, 1830; 200°·3 : 3″·3, 1839

[DRACO]

(Se 181°·8 : 2″·8, 1865 ; De 169°·9 : 2″·5, 1877) : wh., pale wh. Bin. ? Sm period 600 y. ? C. p. m.

ν^1, ν^2 (Σ 35 App. I : 4·6, 4·6). XVII^h 30^m, N 55° 16′ : 5, 5 : 311°·8 : 61″·9 : pale grey. C. p. m.

39 (Σ **2323**, 36 App. I : 4·7, 7·7). Triple. XVIII^h 22^m, N 58° 44′ : 5, 8·5, 7 : 5°·5, 21°·7 : 3″·3, 89″·2 : pale wh., light bl., ruddy. Moving.

o (Σ **2420** : 4·6, 7·6). XVIII^h 49^m, N 59° 14′ : 5, 9 : 347°·6, 1830 ; 345°·5, 1837 : 30″ (De 340°·8 : 31″ ; 1863) : or., lilac.

ψ^1 (Σ **2241** : 4, 5·2). XVII^h 45^m, N 72° 13′ : 5·5, 1838 (Σ 4, 1832 ; De 4·7, 1857) 6 : 14°·9 : 31″·3 : pearly wh., 1838 ; Σ wh. 1832 (with c. p. m.) ; De yel., ashy yel., 1856 [yel., lilac, contrast evident, 1850 ; so Fr 1876]. Wa more than ½ m^g. diff. 1875.

40, 41 (Σ **2308** : 5·4, 6·1). XVIII^h 9^m, N 79° 59′ : 5·5, 6 : 235°·3 : 19″·9 : wh., 1839 ; [yel., paler yel., $3\frac{7}{10}$ in. 1856 ; so 5½ in. 1863 ; grouped finely with smaller lilac star.]

ε (Σ **2603** : 4, 7·6). XIX^h 49^m, N 69° 58′ : 5·5, 9·5 : 354°·6 : 3″·1, 1833 (Hall 361°·4 : 2″·9, 1877) : light yel., bl. : 9·5 var. ? H and South very difficult ; easy to me, and apparently under-rated. Contrast very pleasing. Bin. ?

17 (Σ **2078**, 30 App. I : 5, 6). Triple. XVI^h 33^m, N 53° 10′ : 6, 6·5, 6 (16 Drac.) : 115°·7, 194°·6 : 3″·8, 90″·5 : pale yel., faint lilac, wh. Σ close pair wh., altern. var. 1833.

P XVII 147 (Σ **2180** : 7, 7·2). XVII^h 26^m, N 50° 58′ : 8, 8·5 : 266°·2 : 3″·2 : pale wh., ruddy, 1836 ; De wh., 1854 ; so Du 1871, 1875. 1¾° *s* of *β*, the Dragon's eye.

P XVIII 226 (Σ **2410** : 8·2, 8·7). XVIII^h 45^m, N 59° 11′ : 8, 9 : 98°·1 : 1″·7 [elongated ? $3\frac{7}{10}$ in.] : silver wh. Neat pair *f*.

[DRACO]

Σ 44[1]. XIX^h 31^m, N 59° 52′ : 5·2, 7·2 : 287°·1 : 76″·6 : gold, bl.

Σ 25[1]. XIII^h 9^m, N 67° 55′ : 5·9, 6·3 : 296°·7 : 178″·8 : yel.

Σ 2348. XVIII^h 31^m, N 52° 15′ : 5·9, 8·1 : 272°·7 : 25″·7 : v. yel., v. bl.

Σ 1984. XV^h 48^m, N 53° 15′ : 6·2, 8·5 : 273°·8 : 6″·6 : wh., o. Bin.?

Σ 2573. XIX^h 38^m, N 60° 13′ : 6·2, 8·5 : 29°·7 : 18″·1 : wh., bl.

Σ 2403. XVIII^h 43^m, N 60° 56′ : 6·2, 9 : 258°·7 : 1″·9 : yel., bl.

Σ 1831. XIV^h 12^m, N 57° 16′ : 6·3, 9 : 142°·8 : 6″ : v. wh., ash. (Es Σ **1830** in field : 8·5, 9·8 : 264° : 4″·8 : yelsh., o. Moving.)

Σ 2218. XVII^h 40^m, N 63° 44′ : 6·5, 7·7 : 356°·7 : 2″·5 : wh., ash. Bin.?

Σ 2604. XIX^h 51^m, N 63° 50′ : 6·5, 8·7 : 184°·6 : 27″·8 : yel., bl.

Σ 1573. XI^h 43^m, N 67° 58′ : 6·6, 7·6 : 177°·9 : 11″·1 : wh.

Σ 2452. XVIII^h 58^m, N 75° 37′ : 6·7, 7·5 : 219°·8 : 5″·7 : wh.

Σ 2273. XVII^h 58^m, N 64° 9′ ; 6·8, 7·3 : 284°·7 : 20″·5 : yelsh. wh., blsh. wh.

Σ 2278. XVIII^h 1^m, N 56° 26′ : 6·8, 7·3 : 22°·5 : 38″·9 : wh.—Triple ; 7·8 : 147°·8 : 6″ : wh.

Σ 1516. XI^h 8^m, N 74° 7′ : 7, 7·5 : 298°·7 : 9″·9 : yelsh., ashy yel. 1831. (Se 29°·6 : 2″·6, 1856 ; De 70° : 4″, 1863.—3^d star, OΣ **539**, Du's *min. visib.* $9\frac{6}{10}$ in. 299°·4, 7″·5, 1875. C. p. m. with 7.)

Σ 1872. XIV^h 37^m, N 58° 32′ : 7, 8 : 38°·4 : 7″·5 : yelsh., ashy wh.

[DRACO]

Σ **1927.** $\text{xv}^{\text{h}}\ 10^{\text{m}}$, N 62° 17′ : 7·1, 8 : 353°·9 : 16″·1 : wh.

Σ **2368.** $\text{xviii}^{\text{h}}\ 36^{\text{m}}$, N 52° 13′ : 7·2, 7·4 : 331°·3 : 2″ : yelsh.

Σ **2199.** $\text{xvii}^{\text{h}}\ 36^{\text{m}}$, N 55° 51′ : 7·2, 7·8 : 116°·4 : 1″·7 : yelsh. (Fl bin.)

Σ **1882.** $\text{xiv}^{\text{h}}\ 41^{\text{m}}$, N 61° 33′ : 7·2, 8·7 : 2°·5 : 11″·5 : yelsh. wh., ash.

Σ **2571.** $\text{xix}^{\text{h}}\ 35^{\text{m}}$, N 78° 0′ : 7·3, 8 : 23°·2 : 11″·3 : v. wh.—Angle reversed, Cincinn. 1878–79.

Σ **2271.** $\text{xvii}^{\text{h}}\ 58^{\text{m}}$, N 52° 54′ : 7·3, 8·3 : 262°·3 : 1″·9 : wh. (Fl bin. ?)

Σ **1654.** $\text{xii}^{\text{h}}\ 27^{\text{m}}$, N 75° 28′ : 7·3, 8·8 : 26° : 3″·7 : yel., bl.

Σ **1860.** $\text{xiv}^{\text{h}}\ 30^{\text{m}}$, N 55° 46′ : 7·5, 8·7 : 101°·2 : 1″·2 : v. wh., ashy wh.

Σ **1602.** $\text{xii}^{\text{h}}\ 1^{\text{m}}$, N 69° 46′ : 7·5, 9 : 179°·8 : 13″ : wh., o.

Σ **2006.** $\text{xv}^{\text{h}}\ 58^{\text{m}}$, N 59° 16′ : 7·5, 9·2 : 204°·6 : 1″·6 : yelsh., wh.—Triple; 7·7 : 223°·7 : 43″·5 : yelsh. wh.—Fl probably ternary system.

Σ **2261.** $\text{xvii}^{\text{h}}\ 56^{\text{m}}$, N 52° 14′ : 7·5, 9·5 : 262°·5 : 9″·2 : yelsh. wh., o.

Σ **2284.** $\text{xviii}^{\text{h}}\ 1^{\text{m}}$, N 65° 57′ : 7·6, 9·2 : 193°·7 : 3″·7 : yelsh., ash.

Σ **2549.** $\text{xix}^{\text{h}}\ 30^{\text{m}}$, N 63° 3′ : 7·7, 7·7 : 278°·8 : 47″·5 : yelsh. wh.—Triple; 8·9 between the others.

Σ **1326.** $\text{ix}^{\text{h}}\ 12^{\text{m}}$, N 78° 57′ : 7·7, 8·1 : 171°·4 : 29″ : wh.

Σ **2092.** $\text{xvi}^{\text{h}}\ 38^{\text{m}}$, N 60° 56′ : 7·7, 8·8 : 5°·9 : 8″ : wh.

Σ **2554.** $\text{xix}^{\text{h}}\ 32^{\text{m}}$, N 60° 0′ : 7·9, 8·4 : 197°·3 : 18″·8 : wh.

Σ **2138.** $\text{xvii}^{\text{h}}\ 8^{\text{m}}$, N 54° 40′ : 8, 8·3 : 139°·2 : 22″·3 : v. wh.

[DRACO]

Σ **2207.** XVII^h 37^m, N 67° 11′ : 8, 8·5 : 128°·1 : 1″·1 : rh.

Σ **1767.** XIII^h 31^m, N 68° 22′ : 8, 8·5 : 353°·8 : 4″·7 : rh.

Σ **1969.** XV^h 39^m, N 60° 24′ : 8, 8·7 : 43°·4 : 1″·5 : elsh. wh.

Σ **1948.** XV^h 23^m, N 55° 19′ : 8, 8·7 : 50°·5 : 12″·2 : wh.

Σ **2219.** XVII^h 40^m, N 61° 40′ : 8, 9 : 103°·7 : 17″·7 : el., wh.

Σ **2045.** XVI^h 19^m, N 61° 48′ : 8, 9·2 : 183°·1 : 2″·5 : elsh. wh., o.

Σ **2128.** XVII^h 2^m, N 59° 45′ : 8, 9·2 : 57°·4 : 11″·6 : elsh., o.

Σ **2550.** XIX^h 29^m, N 73° 6′ : 8·2, 8·2 : 248°·8 : 2″ : wh.

Σ **1976.** XV^h 42^m, N 59° 51′ : 8·2, 8·2 : 71°·8 : 18″·8 : rh.

Σ **1698.** XII^h 51^m, N 75° 18′ : 8·2, 8·7 : 109°·5 : 10″·3 : rh.

Σ **2116.** XVI^h 54^m, N 63° 44′ : 8·2, 8·8 : 6° : 18″·9 : r. wh.

Σ **2660.** XX^h 10^m, N 64° 10′ : 8·2, 9 : 167°·6 : 22″ : rh., ash.

Σ **1304.** IX^h 3^m, N 81° 54′ : 8·2, 9 : 317° : 24″·1 : elsh. wh., o.

Σ **2357.** XVIII^h 32^m, N 63° 36′ : 8·3, 9 : 270°·9 : 4″·5 : rh.

Σ **2553.** XIX^h 32^m, N 61° 47′ : 8·4, 9·2 : 80°·3 : 1″·1 : , o. (Moving.—Bird a minute *comes n f.*)

Σ **2307.** XVIII^h 12^m, N 69° 14′ : 8·5, 8·5 : 205°·2 : ″·3 : v. wh.

Σ **1588.** XI^h 56^m, N 73° 2′ : 8·5, 8·7 : 60°·7 : 16″·5 : wh. Moving.)

[DRACO]

Σ **1827.** XIV^h 10^m, N 59° 47′ : 8·5, 9 : 210°·9 : 11″·2 : wh.

Σ **2617.** XIX^h 54^m, N 75° 6′ : 8·5, 9 : 42° : 27″·7 : wh.

Σ **2124.** XVI^h 58^m, N 65° 24′ : 8·5, 9·2 : 88°·9 : 15″·1 : wh.

Σ **2642** (P XX 30). XX^h 4^m, N 63° 22′ : 8·7, 8·7 : 165°·2 : 2″·4 : yelsh. wh.

Σ **2279.** XVIII^h 1^m, N 50° 53′ : 8·7, 8·8 : 182°·8 : 13″ : 0, 0.

Σ **2451.** XIX^h 0^m, N 51° 23′ : 8·7, 9 : 58°·1 : 2″·6 : wh.

Σ **1996.** XV^h 54^m, N 57° 36′ : 8·7, 9 : 109°·4 : 19″·2 : yelsh.

Σ **2478.** XIX^h 3^m, N 69° 15′ : 8·8, 8·8 : 290°·2 : 1″·3 : 0, 0.

Σ **2225.** XVII^h 42^m, N 52° 0′ : 8·9, 9·2 : 319°·4 : 9″·1 : 0, 0.

Σ **2060.** XVI^h 26^m, N 56° 59′ : 9, 9 : 246°·2 : 3″·7 : 0, 0.

[η. XVI^h 22^m, N 61° 47′ : D 2·5, 10 : 141°·4 : 4″·7 : pale yel., bl.—OΣ **312.**]

[46. XVIII^h 40^m, N 55° 25′ : 5, 9 : full yel., clear bl., fine contrast.]

[Pair. XIII^h 23^m, N 65° 20′ : 6·7, 6·7 (A) : yelsh., bl. De 6·2, 6·7 : 147°·1 : 68″·9. A striking object. OΣ^2 **123.**]

Red Star. B 502. XIX^h 26^m, N 76° 20′ : 6·5 : var.?

Nebulæ.

4373 (ℍ IV 37). XVII^h 59^m, N 66° 38′. Plan. very curious. d'A '*unica prope inter nebulas.*' I found very luminous disc, much like a considerable star out of focus. ℍ 35″ diam.; I saw but 15″ or 20″ with $3\frac{7}{10}$ in.; d'A 23″ × 18″. Sm pale bl. ℍ very small nucleus; Bird 1863, 12 in. silv. mirror, like a 10 m^g. star; d'A 11–12 m^g. wh. Huggins gaseous spectrum: the first of these surprising discoveries, 1864, Aug. 29. Nearly half way between

[DRACO]

Polaris and γ Drac. in pole of Ecliptic. About 40′ *n p* Bird finds a delicate triple star, 8·9, 9, 11·8.

(4058 (H I 215). $xv^h\ 3^m$, N 56° 14′. H very bright. d'A 90″ × 30″. Not gaseous.)

(2024 (H I 79). $x^h\ 7^m$, N 74° 0′. d'A nucl.)

EQUULEUS.

This little asterism is easily recognised by the clustering of its stars, and its bearing from Pegasus. There are some good objects, and many interesting low-power fields.

Double Stars.

ε (Σ **2737** : 5·7, 6·2, 7·1). $xx^h\ 53^m$, N 3° 50′ : 5·5, 7·5 : 78°·1 : 11″·2 : pale yel., blsh. lilac. The larger an interesting and beautiful bin. Σ 5·7, 6·2 : 294° : 0″·35, 1835 ; Sm 290° : 0″·5, 1838; Do 289°·1 : 0″·8, 1877. [Separated by disc of 5·5, $9\frac{1}{3}$ in. spec. 1873. 13 mg. star *n f*, 1871.] Se and K suspect motion in 7·5.

β. Quadruple. $xxi^h\ 17^m$, N 6° 18′ : 5·5, 13, 14 : 317°, 275° : 35″, 50″ : lucid wh., grey, bl. 13 has most minute dusky 16 mg. *comes*, 15° : 3″. [Of this most severe test, $3\frac{7}{10}$ in. showed 13 ? only ; 9 in. spec. 13 and 14, now the larger, 1871.] All easy, Bu 6 in. achr. Sa $6\frac{1}{2}$ in. spec. Gore glimpsed 13 and 14, 3 in. achr.

λ (F 2) (Σ **2742** : 7·1, 7·1). $xx^h\ 56^m$, N 6° 42′ : 6, 6·5 ; 225°·6 : 2″·6 : wh. Mitchel 1″·9, 1847 (too small ?). Beautiful close pair. Sm very faint star *n p*.

P XX 376 (Σ **2735** : 6·2, 7·7). $xx^h\ 50^m$, N 4° 5′ : 6, 8 : 286°·8 : 1″·8; Σ, Se, K 2″·1 : or., purp., 1833; De wh., bl., 1854. [Elong. 80 ; clearly divided, 144.] Second star *p* ε, *n*.

[EQUULEUS]

P XX 355, 356 (Σ **2733** : 8, 8·3). xx^h 47^m, N 6° 53′ : 8·5, 8·5 : 145° : 39″·9 : wh.

Σ **2744**. xx^h 57^m, N 1° 5′ : 6·3, 7 : 190°·5 : 1″·5 : wh. (OΣ moving.)

Σ **2786**. xxi^h 14^m, N 8° 58′ : 7, 8·1 : 183°·6 : 2″·5 : wh. (Fl bin.?)

Σ **2787**. xxi^h 15^m, N 1° 30′ : 7, 8·3 : 19°·5 : 22″·7 : wh.

Σ **2793**. xxi^h 19^m, N 8° 52′ : 7, 8·7 : 242°·2 : 26″·5 : wh., o. (Bu 7 close double.)

Σ **2765**. xxi^h 5^m, N 9° 3′ : 7·8, 8 : 85°·7 : 3″ : wh.

Σ **2791**. xxi^h 18^m, N 3° 52′ : 8·5, 9 : 104°·4 : 2″·4 : yelsh. wh.

(δ (Σ **2777**). xxi^h 9^m, N 9° 31′, 4·5 m^g. is an excessively close pair, period most rapid known, 7 or 14 y.? discovered by OΣ, 0″·4, 1852, with distant *comes* 11 m^g. : 34°·5 : 28″·8, 1841; De 25° : 33″·7, 1874 : from great prop. mot. of δ.) [Followed by 3 little stars, singularly arranged in straight line.]

[γ, xxi^h 5^m, N 9° 39′, and 6 (Σ 54 App. I), 5, 6 : pale yel., wh. or blsh. ; a striking pair. K doubles γ, 4·75, 11 : 276°·8 : 2″·1 : pale yel., bl. Sa and Bu *comes* 16 m^g. Bu 10° : 41″·4.]

[Bu 270 (F 19) between *a*. xxi^h 10^m, N 4° 45′, and δ : 7 m^g. open pair, wh.] Bu $9\frac{4}{10}$ in. achr. doubles smaller, 7, 10 : De 354°·6 : 0″·6, with *comes* : est. 30° : 20″.

Red Star. 9. xxi^h 15^m, N 6° 51′ : 6 : or. red. Fr.

ERIDANUS.

An asterism winding down to S. horizon, its *lucida* being out of sight in our latitudes.

[ERIDANUS]

Double Stars.

32 (Σ **470** : 4, 6). III^h 48^m, S 3° 19′ : 5, 7 : 346°·5 : 6″·6 : topaz yel., sea grn. or flushed bl., 1843. H 5 wh., 1827. Se cols *magnifici, superbi.* (A little *n p* are Σ **466.** 8·2, 10·5 : 59°·7 : 8″·1 : yel., o; and Σ **468.** 8·7, 9·7 : 97°·7 : 20″·1).

o^2 (40) (Σ **518** : 4, 9·1). IV^h 10^m, S 7° 50′ : 5, 9·5 : 107°·6 : 83″·9 : or., sky bl. Very rapid c. p. m. 9·5 double, 10·8 : OΣ 155°·8 : 3″·9, 1851; Bu 122° : 3″·2, 1880. Bin. in ± 200 y. Most interesting ternary. Wa faint *comes* to 5; Winnecke 185°·0 : 75″·8, 1864.

39 (Σ **516** : 6, 9). IV^h 9^m, S 10° 33′ : 5, 11 [perfectly easy]: 154° : 7″·1 : full yel., deep bl. Gl moving.

62. IV^h 50^m, S 5° 22′ : 6, 8 : 73°·6 : 63″·8 : pale wh., flushed bl. 2½° *p β* (to which Sm minute *comes*).

P III 98 (Σ **422** : 6, 8·2). III^h 31^m, N 0° 12′ : 6·5, 9 : 231°·8 : 5″·9, 1834 (Gl 240° : 6″·4, 1873) : yel., pale bl. Bin. C. p. m.

55 (Σ **590** : 6·2, 6·7, 1831). IV^h 38^m, S 9° 1′ : 7·5, 7·5, 1832 (Σ 7·2, 7·5, 1820) : 318°·5 : 10″·2 : yelsh. wh.

Bu **11** (ρ^2). II^h 57^m, S 8° 10′ : 5·5, 10 var.? : 85°·1 : 2″·5. De 87°·2 : 2″·7.

Bu **88** (51). IV^h 32^m, S 2° 43′ : 6, 15 : est. 90° : 25″.

Σ **576.** IV^h 33^m, S 13° 16′ : 6·7, 7·2 : 172° : 12″·3 : yelsh. wh. [wh., grey.]

Bu **184.** IV^h 23^m, S 21° 46′ : 7, 8 : 263°·9 : 1″·1.

Σ **570.** IV^h 30^m, S 10° 0′ : 7, 8 : 258°·9 : 12″·8 : wh., blsh.

Σ **436.** III^h 35^m, S 13° 2′ : 7, 8·2 : 232°·4 : 30″·2 : wh., o. (Moving.)

[ERIDANUS]

Bu **403**. IV^{h} 19^{m}, S 2° 20′ : De 7, 8·5 : 100°·9 : 2″.

Σ **649**. V^{h} 3^{m}, S 8° 51′ : 7, 8·7 : 80°·8 : 21″·6 : wh., bl. (H 8·7 v. ruddy.—49^{s} *p*, 5′ *n*, from λ.)

Σ **636**. IV^{h} 57^{m}, S 8° 50′ : 7·5, 8·6 : 100°·4 : 3″·7 : wh. (6^{m} 7^{s} *p*, 4′ *n*, from λ.)

Σ **315**. II^{h} 43^{m}, S 11° 5′ : 7·5, 8·7 : 160°·2 : 2″·5 : yelsh. wh.

Bu **316**. IV^{h} 47^{m}, S 5° 29′ : 8·1, 8·2 : 176°·8 : 1″·2. Beautiful; in field with ω.

Σ **408**. III^{h} 25^{m}, S 4° 41′ : 8, 8·2 : 347°·6 : 1″·4 : wh.

Bu **186**. IV^{h} 40^{m}, S 7° 12′ : 8, 10.—Cincin. 176°·4 : 1″·4.

Σ **624**. IV^{h} 52^{m}, S 5° 57′ : 8·1, 8·6 : 88°·6 : 28″·4 : wh.

Σ **536**. IV^{h} 16^{m}, S 4° 58′ : 8·1, 8·7 : 152°·4 : 1″·8 : v. wh. (Fl slow bin.)

Σ **544**. IV^{h} 19^{m}, S 9° 1′ : 8·3, 9·2 : 356°·7 : 2″·1 : wh., o.

Σ **489**. III^{h} 57^{m}, S 7° 22′ : 8·5, 8·7 : 195°·1 : 3″·3 : wh.

Σ **487**. III^{h} 55^{m}, S 10° 49′ : 8·7, 9·2 : 8°·7 : 11″·9 : o, o.—Triple; 10·3 : 237°·4 : 21″·7.

[Red Star, B 99. V^{h} 4^{m}, S 5° 40′ : 8. Webb.]

Vars. probable, see Es's list, *Eng. Mech.*, Jan. 17, 1879.

Nebulæ.

826 (H IV 26). IV^{h} 9^{m}, S 13° 2′. Plan. bright and round with low powers of $3\frac{7}{10}$ in. but not bearing magnifying. La has described it as the most interesting and extraordinary object of the kind he had ever seen; an 11 m^{g}. star standing in the centre of a circular nebula, itself placed centrally upon a larger and fainter circle of hazy light. d'A did not see this, but thought nucl. excentric, edges resolvable, and col. light bl., as E. of Rosse, who makes nucl.

granular. Huggins finds the spectrum, though, like that of several other nebulæ, deficient at the red end, not gaseous.

(604 (H I 64). $11^h\ 40^m$, S 8° 4′. Oval. d'A 80″ × 50″. Not gaseous.)

(709 (H I 60). $111^h\ 21^m$, S 21° 46′. Continuous spectrum.)

(752 (H I 107). $111^h\ 35^m$, S 18° 58′. Same character. H II 593, fainter, *p.*)

GEMINI.

The leading stars, in the heads of the two figures, are well known, but it requires a little attention to the globe or map to make out the whole constellation.

Double Stars.

α (Σ **1110** : 2·7, 3·7) Castor. $VII^h\ 27^m$, N 32° 9′ : 3, 3·5 ; 258°·8 : 4″·7, 1830 (D 241°·4 : 5″·7, 1865 ; De 236° : 5″·6, 1876) : bright wh., pale wh. Σ grnsh. H calls this the largest and finest of all the double stars in our hemisphere ; the certainty of its motion first fully convinced H of the existence of binary systems. Period not determined : H gives it 253, Sm 240, Jacob 653, Hind and Thiele 997, Do 1001 y. Excellent object for small telescopes. Huggins believes it may be receding from us about 25 miles per second ; (β approaching us 49 miles.)—Nearly 1° *s*, a little *f*, is a severe test—OΣ **175** : 6, 6·6 : De 332°·1 : 0″·8, 1867 ; discovered independently by Bird with 12 in. silvered mirror, and seen by Buffham with 9 in. do. (With) ; or., bl. [Beautifully divided, $9\frac{1}{3}$ in. spec. 1878.]

ε. $VI^h\ 37^m$, N 25° 15′ : 3, 9·5 : 94°·1 : 110″·6 : brilliant wh., cerul. bl., 1831 [3 strong yel., 1849, so Sa 1874]. Fr. yel. 1877. [Fine sweeping here.]

[GEMINI]

μ. vi^h 16^m, N 22° 34′ : 3, 11 : 89° : 80″, 1831 (Bu 76°·6 : 73″, 1880) : crocus yel., blsh. [Tint of 3 very fine. 11 very small, 5½ in. 1863; Sa 13, 1874; Fr 13–14, 1877, 1880.]

γ. vi^h 31^m, N 16° 30′ : 3 : brilliant wh. [With low power, minute stars radiate from it every way; pretty field.]

δ (Σ **1066** : 3·2, 8·2). vii^h 13^m, N 22° 12′ : 3·5, 9 : 196°·8 : 7″·2, 1838 (Gl 204° : 6″·9, 1874) : pale wh., 1838; De yel., decided, 1854; purp. Sa *comes* 14 m^g. est. 180° : 85″.

ζ. Triple. vi^h 57^m, N 20° 45′ : 4, 8, 13 : 355°, 85° : 90″, 65″ : pale topaz, viol., grey. [13 a glimpse-star, 3$\frac{7}{10}$ in.] Sa very easy, 2½ in. achr. Sa and Wa another *comes*, 20″ from 8. Schm 4 var. 4·3—5·4 : period 10^d 3^h 43^m.

κ (OΣ **179** : 4, 8·5). vii^h 37^m, N 24° 41′ : 4, 10 (var. 8·5—14 ?) : 231°·9 : 6″ : or., pale bl. Moving. [Very delicate and beautiful.]

λ (Σ **1061** : 3·2, 10·3). vii^h 11^m, N 16° 45′ : 4·5, 12 : 29°·2 : 10″·3 : wh., yelsh. [Not seen.]

38 (Σ **982** : 5·4, 7·7). vi^h 48^m, N 13° 20′; 5·5, 8 : 171°·8 : 6″, 1836 (Hall 163°·8 : 6″·4, 1876) : light yel., purp. (Bird grnsh.) Σ m^{g3}. var. Very slow bin. C. p.m.

15. vi^h 21^m, N 20° 52′ : 6, 8 : 205°·4 : 33″·2 : flushed wh., blsh., 1832; pale wh., ash-col., 1852; Sestini or., yelsh., 1845; K yel., purp., 1872; so Sa 1875, Fr 1877.

20 (Σ **924** : 6, 6·9, 1830). vi^h 25^m, N 17° 52′ : 8, 8·5, 1833 : 209°·2 : 20″·4 : yel., pale bl.; Whitley both white, 1868. Sa 6, 7 : wh., grnsh. wh. 1875. Field fine; 1½° *n p* γ.

OΣ **165** (O, 45). vii^h 1^m, N 16° 8′ : 5, 10·7 : 89°·7 : 2″·9 : gold, o. Closing, from p. m. of 5.

Σ **1108**. vii^h 26^m, N 23° 7′ : 6·7, 8·5 : 179°·1 : 11″·6 : *yelsh.* wh., blsh. [Beautiful.]

[GEMINI]

Σ **1083.** VII^h 18^m, N 20° 44′ : 6·8, 7·8 : 42°·6 : 6″·2 : yelsh. wh., blsh. wh. (Sa very small star *nf.*)

Σ **1140.** VII^h 41^m, N 18° 38′ : 6·8, 8·5 : 273°·9 : 6″·2 : yel., v. bl.

Σ **899.** VI^h 16^m, N 17° 38′ : 7, 8 : 20°·3 : 2″·4 : yelsh. wh., wh.

Σ **1090.** VII^h 20^m, N 18° 47′ : 7, 8 : 97°·4 : 61″·1 : v. wh.—Triple; 9·5 : 318°·5 : 19″·7.

OΣ **134.** VI^h 2^m, N 24° 27′ : 7, 8·3 : 188°·1 : 31″.

Σ **1088.** VII^h 19^m, N 14° 22′ : 7, 9 : 195°·1 : 11″·1 : wh.—In field with

Σ **1087.** 8·2, 11·5 : 41°·9 : 19″·9 : wh., o.

Σ **1037.** VII^h 5^m, N 27° 28′ : 7·1, 7·1 : 332°·7 : 1″·1 : yelsh. (Bin.)

Σ **1054.** VII^h 10^m, N 35° 9′ : 7·3, 8·5 : 291°·5 : 18″·6 : yelsh. wh., blsh. wh.

Σ **1035.** VII^h 4^m, N 22° 29′ : 7·4, 7·4 : 39°·6 : 8″·5 : yelsh. [Very pretty.]

Σ **957.** VI^h 38^m, N 31° 0′ : 7·5, 9 : 95°·6 : 3″·4 : wh., ash.

Σ **1094.** VII^h 21^m, N 15° 34′ : 7·7, 8·7 : 96°·3 : 2″·4 : wh.

Σ **1000.** VI^h 52^m, N 25° 25′ : 7·7, 8·7 : 66°·9 : 22″·4 : wh.

Σ **1081.** VII^h 17^m, N 21° 41′ : 7·8, 8·5 : 216°·1 : 1″·3 : v. wh. (Fl slow bin.)

Σ **981.** VI^h 48^m, N 30° 23′ : 8, 8 : 149°·3 : 3″·7 : wh. (Bird a minute pair suspected *n p.*)

Σ **1023.** VII^h 1^m, N 25° 13′ : 8, 8·5 : 101°·8 : 24″·7 : yelsh.

Σ **976.** VI^h 44^m, N 18° 50′ : 8, 8·8 : 117°·6 : 35″·7 : o, o.

Σ **991.** VI^h 50^m, N 25° 9′ : 8, 9 : 172°·4 : 3″·8 : v. wh., blsh. (Bin. ?)

Σ **1027.** VII^h 2^m, N 17° 7′ : 8·1, 8·2 : 356°·2 : 6″·7 : wh. (Bird yelsh. red.)

[GEMINI]

Σ 932. VI^h 27^m, N 14° 51′ : 8·2, 8·3 : 341°·7 : 2″·4 : wh. (Fl slow bin.)

Σ 1124. VII^h 34^m, N 22° 6′ : 8·2, 8·4 : 325°·6 : 19″·4 : wh. [In pretty group.]

Σ 897. VI^h 15^m, N 26° 43′ : 8·2, 8·5 : 348°·9 : 18″·1 : wh.

Σ 830. V^h 56^m, N 27° 39′ : 8·2, 8·7 : 249°·6 : 12″·8 : yelsh., o. (Moving.)—Triple; 10·8 : 187°·7 : 25″·2.

Σ 1129. VII^h 35^m, N 18° 20′ : 8·2, 8·7 : 62°·6 : 21″·7 : wh. [3 minute stars *n p*.]

Σ 1070. VII^h 14^m, N 34° 16′ : 8·2, 9·2 : 319°·2 : 1″·9 : wh.

Σ 1068. VII^h 13^m, N 13° 36′ : 8·3, 9 : 354°·3 : 3″·9 : o, o.

Σ 1089. VII^h 20^m, N 15° 5′ : 8·5, 8·5 : 8° : 7″·2 : wh.

Σ 962. VI^h 41^m, N 26° 52′ : 8·5, 8·5 : 241°·2 : 25″·7 : wh. (4^m 7^s *f*, 1° 36′ *n*, from ε).

Σ 943. VI^h 30^m, N 23° 17′ : 8·5, 9 : 165°·9 : 15″·5 : wh. (In rapid motion.)

Σ 1017. VII^h 0^m, N 17° 2′ : 8·5, 9·2 : 254° : 12″·2 : wh. (1^m 16^s *p*, 54′ *n*, from 45).

Σ 1014. VI^h 59^m, N 26° 21′ : 8·7, 8·7 : 32°·2 : 2″·1 : wh.

Σ 1106. VII^h 25^m, N 16° 35′ : 8·7, 8·7 : 211°·2 : 10″·6 : wh.

Σ 1147. VII^h 43^m, N 24° 49′ : 9, 9 : 162°·3 : 2″·5 : wh.

Σ 942. VI^h 30^m, N 23° 47′ : 9, 9·2 : 244°·1 : 3″·3 : wh. (Bird corner of parallelog.)

[H V 66. VII^h 21^m, N 22° 24′ : K 7·6, 9·3 : 276°·7 : 36″ : or., bl., cols. very fine. ± 40′ *n* of 63, 6 m^g. with 3 minute attendants, which is 2° *f δ*, a little *s*.]

[Field with several pairs, ± VI^h 39^m, N 13° 2′.]

[Fine Group, ± VI^h 52^m, N 14° 25′.]

Red stars. [B 144. VI^h 19^m, N 14° 47′ : 6·5 var. Bessel.]

[GEMINI]

B 137. VI^h 5^m, N 22° 56′ : 6·7. Webb.

B 136. VI^h 5^m, N 21° 54′ : 7·3. Birmingham.

[B 135. VI^h 3^m, N 26° 2′ : 7·4. Schwerd.]

[B Add. 27 (Se 101). VI^h 12^m, N 23° 19′ : 7.]

Vars. η. VI^h 8^m, N 22° 32′ : 3·2—3·7, 4·2 : 229^d.

R. VII^h 0^m, N 22° 53′ : 6·6, 7·3—below 12·3 : 371^d : Hind bl. red, yel. by turns. Se wonderful spectrum at *max.* with bright lines.

S. VII^h 36^m, N 23° 44′ : 8·2, 8·7—below 13 : 294^d.

T. VII^h 42^m, N 24° 2′ : 8·1, 8·7—below 13 : 288^d.

U. VII^h 48^m, N 22° 19′ : 8·9, 9·7—13·1, irregular; increase 1858, Nov. 1·5 m^g. per day; 1869 3 m^{gs}. in 24^h!

Clusters and Nebula.

1360 (M 35). VI^h 1^m, N 24° 21′. Beautiful and extensive region of small stars, a neb. to naked eye: how differently La's 24 in. mirror shows it, his own words will best tell:—'A marvellously striking object. No one can see it for the first time without an exclamation . . the field of view, 19′ in diameter and angular subtense 53½°, is perfectly full of brilliant stars, unusually equal in magnitude and distribution over the whole area. Nothing but a sight of the object itself can convey an adequate idea of its exquisite beauty.' Sm observes that the stars form curves, often commencing with a larger one [elegant festoon near centre, starting with a reddish star; 9 in. spec.: see note on Sagittarius, *infra*]. Between ϵ Gem. and ζ Taur. a little *n*; in fine region. About ½° *sp*, just beyond a group of out-

[GEMINI]

liers, is 1351 (H VI 17), a faint dim cloud of very minute stars.

1549 (H VI 1). VII^h 31^m, N 21° 50′. Faint mass of very small stars; H 11–18 m^g. [beautiful, and in rich region; 9 in. spec.]

1532 (H IV 45). VII^h 22^m, N 21° 9′. H observed this object as a 9 m^g. star, 'with a pretty bright nebulosity, equally dispersed all around: a very remarkable phænomenon.' H describes it as an 8 m^g. star, 'exactly in the centre (not exactly, E. of Rosse, d'A.) of an exactly round bright atmosphere 25″ in diameter.' Sm who rates it 7·5 m^g. says he 'could only bring it to bear as a burred star.' I was so much surprised at the result in my inferior telescope, that I cannot help supposing some temporary impediment to distinct vision at Bedford, for on coming accidentally across it in 1850 I found such a conspicuous nebulosity that I thought it was either damp on the eye-lens, or a telescopic comet; and in 1852 I entered it as 'a blsh. nebulosity quite like a telescopic comet.' 1865, with 5½ in. I perceived a very faint trace of a brighter border *s* a little *f*. The E. of Rosse saw a marvellous object: a star surrounded by a small circular neb., in which, close to the star, is a little dark spot; this neb. is encompassed, first by a dark, then by a luminous ring, very bright, and always flickering; perhaps a spiral. Buffham sees the dark ring with 9 in. 'With'; Key's 18 in. mirror showed 2 concentric bright rings and the dark spot, 1868. A mass of luminous gas. It lies 2° *s f* δ.

HERCULES.

Some very noteworthy telescopic objects mark this constellation; and there is very fine sweeping in its *s f* portion, the *Ramus Pomifer* of Bayer, *Cerberus* of Hevel.

[HERCULES]

Double Stars.

ζ (Σ **2084** : 3, 6·5). XVI^h 37^m, N 31° 49′ : 3, 6 : 190° : elong. 1835 ; 136°·9 : 1″·2, 1842 ; 83°·8 : 1″·3, 1852 : yelsh. wh., or. Most remarkable bin. with mutual occultation. Σ 23°·4 : 0″·9, 1826 ; single 1828–31 ; 203°·5 : 0″·9, 1834 ; Fletcher 59°·2 : 1″·4, 1857 ; single, 9½ in. 1000, 1865 ; A. Clark double, 7 in., 1865 ; D 225°·1 : 1″, 1866 ; K 206°·5 : 1″, 1868 ; 183°·3 : 1″, 1871 ; Do 124°·9 : 1″·3, 1878 ; Bu 114°·3 : 1″·4, 1880. Du's period 35 y.

α (Σ **2140** : 3, 6·1). XVII^h 9^m, N 14° 32′ ; 3·5, 5·5 : 118°·7 : 4″·5 : or., emerald or blsh. grn. Sm calls it a 'lovely object, one of the finest in the heavens.' ℍ 3·5 var. 3 to 4 m^g. ; Σ not, but 5·5 var. 5 to 7 m^g. ; A, not 5·5 but 3·5 var. in 66·4^d ; Baxendell 88·5^d ; Schm 97·3^d, ranging from 86^d to 113·4^d. Apparently stationary. Sm two small stars, 10, 12 *nf*, lilac.

γ. XVI^h 17^m, N 19° 26′ : 3·5, 10 : 242°·3 : 38″·7 : silv. wh., lilac. [Not exam^d.]

ρ (Σ **2161** : 4, 5·1). XVII^h 20^m, N 37° 15′ : 4, 5·5 308°·9 : 3″·7 : blsh. wh., pale emerald, 1839 ; De grnsh. wh., 1853, very fine grn., 1855. Angle changing. B smaller pair *sf* ; Fr 6·5, 9 : ± 10° : 30″ : bright yel., bl. [ρ is the gem of a beautiful coronet, in a large field.]

δ (Σ **3127** : 3, 8·1). XVII^h 10^m, N 24° 59′ : 4, 8·5 : 173°·9 : 25″·9, 1830 (K 179°·6 : 20″·2, 1866 ; 180°·3 : 19″·3, 1871 ; De 182°·2 : 18″·3, 1877) : grnsh. wh., grape red, 1830–7–9 ; Σ grn., ashy wh. ; Fletcher yel., red, 1851 ; De yel., bl., 1854–5 ; wh., bl., 1855–6 ; K pale yel., ruddy purp., 1871 ; [pale yel., blsh. grn., 1850.]

μ (Σ **2220** : 3·8, 9·5). XVII^h 42^m, N 27° 48′ : 4, 10 : 241°·8 : 30″·1 : pale straw col., cerul. bl. Relatively fixed.

or nearly so, with c. p. m.; their real sizes must widely differ. 10 was found double, 10·5, 11, by A. Clark, 1856. D rapid bin., 60°·4 : 2″, 1859; 77°·6 : 1″·8, 1864; Buffham est. 0″·7, 1868.—OΣ 85° : 1″·1, 1866; Hall 220°·6 : 1″·2, 1875; Bu 245°·9 : 1″, 1880.

λ. XVII^{h} 26^{m}, N 26° 12′ : 4·5 : inserted for its curious col., with my $3\frac{7}{10}$ in. deep, dull or. Towards this point the solar system, according to HH and A., is moving.—Fr small pair *sp* : 10, 11 : est. 90° : 5″.

110. XVIII^{h} 41^{m}, N 20° 26′ : 5, 16 : 110° : 55″ : pale yel., dusky; *minim. visibile*, 1831. [5½ in. pretty steady, 1862.] Buffham easy, 6½ in. 'With' spec. 1868. Wa 5 *comites*.

95 (Σ **2264** : 4·9, 4·9). XVII^{h} 56^{m}, N 21° 36′ : 5·5, 6 : 261°·8 : 6″·1 : light apple-grn., cherry-red. Sm observes that 'this beautiful object presents a curious instance of difference in colour between components so nearly equal in brightness.' Se thinks red the larger, grn. the brighter. Strange discrepancies as to col. P Sm tints var. Macdonnell at Sydney, both gold. yel. Extremely pretty; to find it, mark, on map, its configuration with *a* Herc. and *a* Oph.

κ^{1}, κ^{2} (Σ **2010** : 5, 6). XVI^{h} 3^{m}, N 17° 22′ : 5·5, 7 : 9°·7 : 31″·4 : pale yel., redsh. yel. Some diff. as to col.

23. XVI^{h} 18^{m}, N 32° 37′ : 6, 9 : 20°·1 : 36″·2 : wh., viol. 1½° *s* of *ν* Cor.

42 (Σ **2082** : 4, 10·7). XVI^{h} 35^{m}, N 49° 10′ : 6, 12, 1835; 93°·5 : 20″ : or., bl. : a still minuter *comes*, 12 m^{g}. [glimpsed with $3\frac{7}{10}$ in. 1851.] B 10 m^{g}., 4½ in. 1871; with little pair in field.

56 (Σ **2110** rej). XVI^{h} 50^{m}, N 25° 56′ : 6·5, 13 : 96°·1 : 15″ : light yel., pale red. An 11 m^{g}. *comes*, 170° : 540″. Sm very severe test, 5·9 in. 3 more minute stars. [Not exam^{d}.]

[HERCULES]

P XVII 200 (Σ 2194 : 6·2, 8·5). XVII^h 36^m, N 24° 34′ : 6·5, 9 : 9°·5 : 16″·3 : topaz yel., purp. [Good low-power field *f*.]

100 (Σ 2280 : 5·9, 5·9). XVIII^h 3^m, N 26° 5′ : 7, 7 : 2°·8 : 14″·1 : pale wh. [Angle reversed 1880; so H and S; but I as Sm, 1855.] 2 faint *comites*; so Hunt.

P XVII 300 (Σ 2245 : 7, 7, 1829). XVII^h 51^m, N 18° 20′ : 7·5, 8, 1835 : 114°·9 : 2″·5 : lucid wh.

46 (Σ 2095 : 7, 9). XVI^h 40^m, N 28° 35′ : 7·5, 10 : 163°·8 : 5″·1 : pale wh., sky bl. Fr 7·5 yelsh., 1876.

OΣ 328 (68). XVII^h 13^m, N 33° 14′ : 4·8, 10·2 : 61°·8 : 4″·4 : wh., o. (4·8 Schm var. 4, 4·6—5·4, 6, irregular: red.)

Σ 2063. XVI^h 28^m, N 45° 51′ : 5·7, 8·2 : 194°·3 : 16″·2 : wh., o.

Σ 31[1] (36, 37). XVI^h 35^m, N 4° 26′ : 6, 7 : 230°·1 : 69″·7 : wh.

Σ 2289. XVIII^h 5^m, N 16° 27′ : 6, 7·1 : 243°·1 : 1″·2 : yel., blsh. [Fl slow bin.]

Σ 2190. XVII^h 31^m, N 21° 5′ : 6, 9·5 : 33°·2 (23°·2 ?) : 10″·2 : blsh. wh., o.

Σ 2104. XVI^h 44^m, N 36° 9′ : 6·2, 8 : 19°·6 : 5″·9 : wh., ash. [Very pretty.]

Σ 2277. XVIII^h 0^m, N 48° 29′ : 6·3, 8·2 : 117°·9 : 27″·6 : wh., o.

Σ 2101. XVI^h 41^m, N 35° 52′ : 6·3, 9·0 : 60°·2 : 4″·3 : yelsh. wh., o.

Σ 2120. XVII^h 0^m, N 28° 15′ : 6·4, 9·2 : 11°·4 : 3″·8 : yel., v. bl., 1829; 7, 9 : 0°·2 : 3″·1 : red, bl., cols. remarkable, 1836. (De 255°·9 : 4″·5, 1877; K 7 tawny; De pale yel.; Fr dusky or., 1876. Moving.)

[HERCULES]

Σ **2049.** XVI^h 23^m, N 26° 14′: 6·5, 7·5: 215°·2 : 1″·1 : wh.

Σ **2107.** XVI^h 47^m, N 28° 51′ : 6·5, 8 : 148°·6 : 1″·1 : yelsh., blsh. (De 8 *sombre*. Bin.)

Σ **2007.** XVI^h 1^m, N 13° 39′ : 6·5, 8 : 328°·2 : 32″ : yelsh. wh., wh. [A very fine pair. Fl in Serp.]

Σ **2415.** XVIII^h 50^m, N 20° 28′ : 6·6, 8·5 : 298°·7 : 2″ : yelsh., blsh.

OΣ **358.** XVIII^h 31^m, N 16° 53′ : 6·8, 7·2 (vars.?) : 202°·1 : 1″·8 : yelsh. Bin?

Σ **32**[1]. XVI^h 54^m, N 47° 32′ : 7, 7·1 : 263°·2 : 114″·6 : yel.

Σ **2259.** XVII^h 54^m, N 30° 3′ : 7, 8 : 278°·6 : 19″·4 : yel., bl.

Σ **2232.** XVII^h 45^m, N 25° 18′ : 7, 8·5 : 142°·9 : 6″·5 : wh., blsh.

Σ **2165.** XVII^h 22^m, N 29° 33′ : 7, 8·5 : 45°·7 : 6″·7 : yelsh., ash. (Moving.)

Σ **2401.** XVIII^h 44^m, N 21° 1′ : 7, 8·6 : 37°·6 : 4″·1 : wh., blsh.

Σ **2178.** XVII^h 25^m, N 35° 4′ : 7, 8·6 : 130°·1 : 10″·6 : yelsh., blsh.

Σ **2079.** XVI^h 35^m, N 23° 15′ : 7·1, 7·9 : 90°·9 : 16″·8 : wh. (Fr cols. different, 1876.)

Σ **2135.** XVII^h 7^m, N 21° 23′ : 7·1, 8·4 : 166°·1 : 6″·7 : yelsh., blsh. (Fl bin.?)

Σ **2051.** XVI^h 24^m, N 10° 50′ : 7·1, 8·6 : 18°·9 : 13″·5 : yelsh., blsh.

Σ **2320.** XVIII^h 23^m, N 24° 36′ : 7·1, 9 : 11°·4 : 1″·8 : v. wh., ash.

Σ **2319.** XVIII^h 23^m, N 19° 14′ : 7·2, 7·6 : 191° : 5″·6 : wh.—Triple, 10 : 279° : 38″·4.

OΣ **313.** XVI^h 29^m, N 40° 22′ : 7·2, 7·8 : 162°·2 : 0″·8.

Σ **2339.** XVIII^h 28^m, N 17° 39′ : 7·2, 8 : 271°·5 : 2″·3 : wh., bl.

Σ **2282.** XVIII^h 3^m, N 40° 22′ : 7·2, 8·2 : 93°·2 : 2″·4 : v. wh.

[HERCULES]

Σ **2094.** XVI^h 39^m, N 23° 42′ : 7·3, 7·6 : 82°·8 : 1″·6 : yelsh. wh.—Triple; 11 : 311°·4 : 25″·3.

OΣ **335.** XVII^h 41^m, N 21° 56′ : 7·3, 8·3 : 140°·3 : 25″.

Σ **2085.** XVI^h 37^m, N 21° 48′ : 7·3, 8·8 : 309° : 6″·1 : wh., o.

Σ **2052.** XVI^h 24^m, N 18° 41′ : 7·5, 7·5 : 109°·7 : 3″ : wh. (Slow bin. C. p. m.)

Σ **2091.** XVI^h 38^m, N 41° 25′ : 7·5, 8 : 302°·2 : 1″·3 : wh.

Σ **2047.** XVI^h 20^m, N 47° 54′ : 7·5, 8 : 333°·2 : 2″·3 : wh.

Σ **2213.** XVII^h 40^m, N 31° 11′ : 7·5, 8 : 332°·3 : 4″·3 : wh.

Σ **2168.** XVII^h 22^m, N 35° 51′ : 7·5, 8·2 : 199°·7 : 2″·4 : yel., o.

OΣ **346.** XVIII^h 10^m, N 19° 43′ : 7·5, 8·3 : 327°·7 : 5″·5.

Σ **2131.** XVII^h 5^m, N 30° 30′ : 7·5, 8·5 : 179°·4 : 24″·3 : v. wh., o.

Σ **2360.** XVIII^h 34^m, N 20° 49′ : 7·5, 8·7 : 5°·7 : 2″·5 : wh., ash.

Σ **2015.** XVI^h 5^m, N 45° 42′ : 7·7, 8·8 : 159°·3 : 2″·7 : v. wh., blsh. wh.

Σ **2242.** XVII^h 48^m, N 44° 56′ : 7·8, 7·8 : 327° : 3″·5 : wh.

Σ **2044.** XVI^h 20^m, N 37° 21′ : 7·8, 8 : 346°·9 : 8″·5 : wh. [Very pretty. Easily found from M 13.]

Σ **2164.** XVII^h 20^m, N 47° 23′ : 7·8, 9·3 : 16°·5 : 8″·8 : wh.

Σ **2056.** XVI^h 26^m, N 5° 40′ : 7·9, 9 : 318°·1 : 6″ : wh., ash.

Σ **2267.** XVII^h 58^m, N 40° 11′ : 8, 8 : 234°·2 : 1″·4 : wh. (Fl bin.) [Triplet.]

Σ **2292.** XVIII^h 7^m, N 27° 37′ : 8, 8·1 : 261°·2 : 1″·4 : v. wh.

Σ **2065.** XVI^h 29^m, N 40° 15′ : 8, 8·7 : 218°·7 : 30″·5 : wh.

Σ **2023.** XVI^h 9^m, N 5° 49′ : 8, 9 : 235°·9 : 1″·5 : yelsh. (Fl in Serpens : bin. ?)

Σ **2098.** XVI^h 41^m, N 30° 11′ : 8, 9 : 147°·2 : 14″·3 : o, o.

Σ **2268.** XVII^h 58^m, N 25° 22′ : 8, 9 : 218°·2 : 18″·1 : yelsh. wh., wh.

[HERCULES]

Bu 417. XVII^h 52^m, N 39° 27′ : 8, 9·5 : De 270° : 1″·5 : (In field with Σ 2246.)

Σ 1956. XV^h 29^m, N 42° 15′ : 8, 9·5 : 41°·4 : 2″·7 : yelsh. wh., o.

Σ 2027. XVI^h 9^m, N 4° 35′ : 8·2, 8·2 : 75°·2 : 2″ : wh. (In Serpens?)

Σ 2087. XVI^h 38^m, N 23° 51′ : 8·2, 8·2 : 291°·8 : 5″·7 : wh. [Exquisite little object.]

Σ 1993. XV^h 55^m, N 17° 44′ : 8·2, 8·2 : 37°·7 : 34″ : wh. (Fl in Serpens.)

Σ 2059. XVI^h 26^m, N 38° 20′ : 8·2, 8·3 : 209°·2 : 1″·2 : wh.

Σ 2000. XV^h 58^m, N 14° 18′ : 8·2, 9 : 230°·1 : 2″·5 : wh.

Σ 2137. XVII^h 9^m, N 16° 7′ : 8·2, 9·2 : 145°·4 : 4″ : wh.

Σ 2182. XVII^h 27^m, N 23° 59′ : 8·2, 9·2 : 0°·9 : 5″·3 : wh.

Σ 2263. XVII^h 56^m, N 26° 34′ : 8·2, 9·2 : 161°·8 : 7″·3 : wh.

Σ 2068. XVI^h 31^m, N 47° 30′ : 8·3, 8·3 : 257°·1 : 5″·5 : v. wh.

Σ 2205. XVII^h 39^m, N 17° 46′ : 8·3, 8·7 : 291° : 2″·5 : v. wh. (Fl in Oph. and bin.?)

Σ 2243. XVII^h 49^m, N 36° 8′ : 8·3, 8·8 : 46°·7 : 1″·7 : yel.

Σ 2246. XVII^h 51^m, N 39° 32′ : 8·3, 8·8 : 102°·5 : 5″·5 : wh.

Σ 2083. XVI^h 37^m, N 13° 50′ : 8·3, 8·8 : 336°·3 : 12″·6 : o, o.

Σ 2371. XVIII^h 37^m, N 27° 33′ : 8·5, 8·5 : 55°·5 : 9″·6 : wh.

Σ 2097. XVI^h 40^m, N 35° 57′ : 8·5, 8·7 : 89°·9 : 2″·1 : o, o. (Fl bin.?)

Σ 2258. XVII^h 54^m, N 48° 39′ : 8·5, 8·7 : 221°·4 : 2″·6 : v. wh.

Σ 2214. XVII^h 40^m, N 43° 47′ : 8·5, 8·8 : 211°·7 : 19″·4 : o, o. (De triple, 9·5, 11 : 143°·3 : 1″·5. Bu moving.)

Σ 2162. XVII^h 20^m, N 36° 37′ : 8·5, 8·9 : 277°·7 : 1″·3 : wh.

Σ 2239. XVII^h 47^m, N 28° 17′ : 8·5, 9 : 318°·3 : 2″·2 : o, o.

Σ 2309. XVIII^h 15^m, N 25° 28′ : 8·5, 9 : 354°·7 : 3″·5 : wh.

[HERCULES]

Σ **2247.** XVII^h 55^m, N 29° 28′ : 8·5, 9 : 191°·2 : 11″·4 : wh.

Σ **2301.** XVIII^h 11^m, N 23° 56′ : 8·5, 9 : 122°·6 : 22″·7 : yelsh., bl.

Σ **2291.** XVIII^h 6^m, N 34° 0′ : 8·5, 9 : 339°·2 : 25″·1 : wh.

Σ **2112.** XVI^h 54^m, N 32° 0′ : 8·5, 9·5 : 260°·6 : 1″·9 : o, o.

Σ **2153.** XVII^h 15^m, N 49° 25′ : 8·6, 9·1 : 281°·8 : 1″·9 : yelsh. (Fl bin?)

Σ **1961.** XV^h 30^m, N 43° 57′ : 8·7, 9 : 56° : 21″·6 : o, o. (Moving.)

Σ **2071.** XVI^h 33^m, N 13° 55′ : 8·7, 9 : 311°·6 : 25″·1 : o, o.

Σ **2152.** XVII^h 14^m, N 45° 42′ : 8·8, 9 : 248°·8 : 1″·8 : wh.

Σ **2037.** XVI^h 14^m, N 17° 41′ : 9, 9 : 238°·2 : 1″·6 : o, o.

Σ **2057.** XVI^h 26^m, N 19° 32′ : 9, 9·2 : 264°·6 : 4″·9 : o, o.

[π. XVII^h 11^m, N 36° 57′ : 3·5 : fine or : has little pair *s f*, yelsh., blsh.]

[P XVI 125, 126. ± XVI^h 30^m, N 17° 18′ : 7 (6 Heis), 8.]

Red Stars. P XVIII 51. XVIII^h 15^m, N 29° 38′ : 6·5 : or. red, Fr (*s p* 108.)

B 437. XVIII^h 17^m, N 25° 0′ : 7·5.

Vars. 30. XVI^h 25^m, N 42° 9 : 5—6·2 : irregular.

33. XVI^h 31^m, N 7° 21′ : 6—8.

R. XVI^h 1^m, N 18° 43′ : 8, 9—below 13 : 319^d, lengthening : red.

S. XVI^h 46^m, N 15° 9′ : 5·9, 6·8—11·5, 12·2 : 303^d, unsteady : red.

T. XVIII^h 5^m, N 31° 0′ : 7·2, 8·3—11·4, 12·1 : 165^d : red.

U. XVI^h 20^m, N 19° 10′ : 6·6, 7·7—11·4, 11·6 : 408^d.

V. XVI^h 3c^m, N 37° 38′ : 8·3—below 11 : period undetermined : wh. *max.*; ruddy *min.* Du.

Clusters, Nebulæ, and Groups.

4230 (M 13). XVI^h 37^m, N 36° 41′. Superb globular cl. lying $\frac{1}{3}$ from η towards ζ; finest of its class; just visible to naked eye. Halley discovered it in 1714; M was *sure* it contained *no stars*; but it is spangled with glittering points in a $5\frac{1}{2}$ f. achromatic, and becomes a superb object in large telescopes. H speaks of thousands of stars, 10 or 11 to 15 or 20 m^g.; his father had estimated them at 14,000. Sm calls it 'an extensive and magnificent mass of stars, with the most compressed part densely compacted and wedged together under unknown laws of aggregation:' H describes 'hairy-looking curvilinear branches' [well seen with 8 in. 'With' mirror]: E. of Rosse, who noticed this spiral tendency, detected also 3 dark 'lanes' or rifts in its interior, beautifully seen by Buffham with 9 in. 'With' mirror. I have also perceived them. Huggins finds spectrum continuous, but red end wanting. (See 116 (M 31) And: and 826 (H IV 26) Erid: *antea.*) In Se's achr. the outliers, inconspicuous in ordinary instruments, fill a field of 8′. Klein has well remarked that our understanding strives in vain to answer the enquiry, What is the object of these thousand on thousand suns? The mere aspect of this stupendous aggregation is indeed enough to make the mind shrink with a sense of the insignificance of our little world. Yet the Christian will not forget that, as it has been nobly said, HE took of the dust of this earth, and with it HE rules the universe!

The neighbourhood is beautiful with a low power. A faint neb: ± 40′ *n.f.*

4294 (M 92). XVII^h 13^m, N 43° 16′. Very fine cl. though not equal to M 13; less resolvable; intensely bright in centre; d'A justly calls it, with his great 11 in. achr. at

[HERCULES]

Copenhagen, *acervus adspectu jucundissimus.* In H's reflectors, 7′ or 8′ diam. Buffham, with 9 in. spec. found stars brighter and more compressed than in M 13, but blaze resolved by glimpses. Spectrum as M 13.

4234 (Σ 5 N). XVI^h 39^m, N 24° 1′. Plan. neb. 8″ diam; discovered by Σ. [Very bright (d'A equal to 8 m^g. star); small; not sharply defined; exactly like a star out of focus, bearing power well. 111 of 5½ in. showed a glow round it.] E. of Rosse intense bl. Se thought it resolved with a power of 1,500; but the spectroscope shows it gaseous. Rather more than 1° *s p* 51, 5 m^g.

4244 (H IV 50). XVI^h 44^m, N 47° 44′: Plan. neb. faint with $3\frac{7}{10}$ in. but beautifully grouped in a triangle with two 6 m^g. stars. d'A very crowded cl.

111. XVIII^h 41^m, N 18° 3′: has an interesting large field *n*, including bright or. star, B.

[101. XVIII^h 3^m, N 29° 2′, has, 6^m *p*, 25′ *s*, 3 stars in line, 8, 7, 8: wh., wh., pale red; *nf* of which is a fainter group with similar line of stars 10σ m^g.]

[Recurved line of small stars proceeding from 7·5 m^g. ±XVI^h 32^m, N 31° 10′.]

[Wreath of stars 11 m^g. attached to 8·5 m^g. ±XVII^h 59^m, N 26° 20′.]

[Double chain of stars 9 m^g. ± XVIII^h 5^m, N 23° 45′.]

[The above are specimens of a peculiarly interesting, but hitherto little noticed class of objects, to which the persevering student may make large and very curious additions, with an increasing conviction as to their mutual interdependence.]

HYDRA.

A very lengthy and not very interesting constellation to the unaided eye; but containing some telescopic work.

Double Stars.

ϵ (Σ **1273** : 3·8, 7·8). VIII^h 40^m, N 6° 51′ : 4, 8·5 : 198°·4 : 3″·4, 1837 (Gl. 218°·5 : 3″·5, 1876) : pale yel., purp. Missed by ℍ. Bin : Sm suggests in about 450, Fl 700 y. Distance unchanged. C. p. m. Hall and Bu very minute *comes*, 192°·2 : 20″·5. (Sa easy, 12½ in. 'Calver' spec.)

θ. IX^h 8^m, N 2° 47′ : 4·5, 12 : 168°·6 : 45″ : pale yel., ash. Es good test. [12 not seen, $3\frac{7}{10}$ in. achr.]

54.[1] XIV^h 39^m, S 24° 56′ : 5·5, 7·5 : 138°·4 (128°·4 !) : 9″·8 : deep yel., redsh. viol.

r^1. IX^h 23^m, S 2° 15′ : 5·5, 8·5 : 2°·9 : 64″·9 : pale wh., dusky.

P VIII 108 (Σ **1245** : 6, 7). VIII^h 29^m, N 7° 2′ : 6, 7 : 24°·9 : 10″·5 : full yel., flushed. Finely grouped with other stars ; 1° *n p* δ (in the head).

P VIII 160 (Σ **1270** : 6·6, 7·6). VIII^h 39^m, S 2° 10′ : 7, 8 : 258°·9 : 4″·9 ; silvery wh., smalt bl., 1833 : Se wh. 1857.

17 (Σ **1295** : 7·2, 7·3). VIII^h 50^m, S 7° 31′ : 7·5, 7·5 : 357°·8 : 4″·5 : wh. 1838 ; Se yel., bl. 1857.—Bu pair ± 45′ *s*, De 7·9, 9 : 171°·9 : 1″.

P IX 65, 64 (Σ **1347** : 6·7, 8). IX^h 17^m, N 4° 0′ : 8, 9 : 309°·8 : 21″·6 : wh., 1836 [redsh. wh., grey or blsh., 1851].

P X 159 (Σ **1473** : 8, 8·9). X^h 42^m, S 15° 0′ : 8, 9 : 10° : 31″·5 : pale wh., light bl. [This points to a much finer object, triple, Σ **1474**. X^h 42^m, S 14° 38′ : 6·9, 8 : 22°·2 : 71″·7 : v. wh., with 8 : 193°·9 : 6″·6. 1½° *n* of *r*.]

[1] 10 of Sm and Harding, but in error.

[HYDRA]

Bu **239** (59). XIV^h 52^m, S 27° 10′ : 6, 6 : 129°·5 : 0″·9.

Bu **341**. XII^h 57^m, S 19° 56′ : 6, 6 : De 136°·4 : 0″·8. (Heis in *Corvus*.)

Σ **1416**. X^h 6^m, S 15° 29′ : 6·7, 8·5 : 275°·8 : 11″·3 : wh., o.

Σ **1365**. IX^h 25^m, N 2° 1′ : 7, 8 : 162°·8 : 3″·1 : yelsh., blsh. wh.

Σ **1255**. VIII^h 33^m, N 6° 14′ : 7, 8 : 31°·1 : 26″·6 : yelsh. wh., wh.

Bu **212**. IX^h 10^m, S 7° 51′ : 7, 9 : De 230°·5, 1″·5.

OΣ **195** (P VIII 200). VIII^h 47^m, N 8° 53′ : 7·4, 7·9 : 138°·9 : 9″·5.

Σ **1348**. IX^h 18^m, N 6° 50′ : 7·5, 7·6 : 334°·3 : 1″·1 : wh. (Fl bin.)

Σ **1260**. VIII^h 35^m, S 11° 44′ : 7·8, 8·3 : 301°·4 : 4″·9 : wh.

Σ **1281**. VIII^h 41^m, N 0° 29′ : 7·8, 8·9 : 329°·6 : 25″ : yelsh. wh. (Moving.)

Σ **1198**. VIII^h 5^m, N 1° 38′ : 8, 8·2 : 157°·5 : 33″ : wh.—vars?

Σ **1309**. IX^h 0^m, N 3° 17′ : 8, 8·3 : 273°·1 : 11″·3 : wh. (near θ.)

Bu **336**. IX^h 6^m, S 16° 19′ : 8, 9 : De 238°·3 : 1″·9.

Bu **339**. IX^h 25^m, S 15° 13′ : 8, 9·5 : De 215°·8 : 1″·3.

Σ **1329**. IX^h 10^m, S 0° 44′ : 8·3, 8·5 : 245°·7 : 27″·2 : wh. (Moving.)

Σ **1302**. VIII^h 55^m, N 3° 13′ : 8·7, 8·8 : 228°·1 : 2″·4 : wh.

Σ **1343**. IX^h 14^m, N 5° 31′ : 8·7, 9·2 : 271° : 10″ : wh. (near P IX 65, *supra*.) (Closing.)

[HYDRA]

Σ 1292. VIII^h 47^m, S 0° 5′ : 8·8, 9 : 188°·8 : 5″·8 : wh.

[Pair 8 m^g. ± 1° *f* γ. XIII^h 13^m, S 22° 13′.]

Red Star. B 248. X^h 46^m, S 20° 37′ : 6.

B 313. XIII^h 42^m, S 27° 46′ : 6·8 : *comes* 10 : bl. In Centaurus. Bu very fine ruby.

Vars. R. (P XIII 94). XIII^h 23^m, S 22° 40′ : 4, 5·5—10? 469^d diminishing.

S. VIII^h 47^m, N 3° 31′ : 7·5, 8·5—below 12·2 : 256^d.

T. VIII^h 50^m, S 8° 41′ : 7, 8·1—below 12·5 : 289^d.

Nebula.

2102 (H IV 27). X^h 19^m, S 18° 2′. Plan. neb. 2° *s* of *μ*, resembling Jupiter, Sm says, in size, equable light and colour. I found it bright, a little elliptical *n p*, *s f*, of a steady pale blue light, bearing high powers. H did not resolve it. Se, whose beautifully defining glass accomplished marvels with 1,000, found it an unique object; within a circular nebulosity two clusters connected by two semi-circular arches of stars forming a sparkling ring, with one star on the hazy ground of the centre. d'A made out two nuclei near the limb. Huggins sees an oval ring surrounded by broad faint nebulosity; but its spectrum is that of gas, and the bright points can hardly be solid matter.

LACERTA.

A small and not distinctly marked asterism. Glorious sweeping from Cygnus in this direction, and towards head of Cepheus.

[LACERTA]

Double Stars.

8 (Σ **2922** : 6, 6·5, 10·2, 1831). Quadruple. XXII^h 31^m, N 39° 1′ : 6·5, 6·5 (P), 11, 10, 1834 (De 5·5, 6·5, 1858 ; Du 6·3, 6·9, 1868 ; Fr nearly 1 m^s. diff. and 10 fully 2 m^{ss}. above 11, 1876. So I saw them, 1878) : two nearest 185°·5 : 22″·5 : two wh., grnsh., bl. (Sm a distant 5th star *s p.*)

P XXII 65 (Σ **2894** : 6, 8·2). XXII^h 14^m, N 37° 10′ : 6·5, 9 : 193°·4 : 15″·2 : pale wh., 1835 (Du 1868, De 1875 decided yel.), livid. Closely *f* 1, 5 m^s.

Σ **2942**. XXII^h 39^m, N 38° 51′ : 7, 9·2 : 282°·1 : 2″·7 : redsh. gold, ash.—Bu triple ; 12 : 232° : 10″·9.

Σ **2902**. XXII^h 18^m, N 44° 45′ : 7·1, 8 : 89°·9 : 6″·4 : yel., wh.

OΣ **469**. XXII^h 15^m, N 34° 31′ : 7·2, 8·8 : 280°·6 : 31″·8 : Moving.

Σ **2916**. XXII^h 26^m, N 40° 38′ : 7·3, 8·8 : 335°·3 : 45″·2 : yel., o.—Triple ; 10·2 : 30°·6 : 3″·5 from 8·8.

Σ **2876**. XXII^h 7^m, N 37° 3′ : 7·7, 9·2 : 68°·4 : 11″·8 : wh., o.

Σ **2917**. XXII^h 26^m, N 52° 55′ : 8, 8 : 71°·2 : 4″·7 : wh.

Σ **2946**. XXII^h 44^m, N 39° 52′ : 8, 8 : 253°·1 : 5″ : wh.

Σ **2891**. XXII^h 11^m, N 47° 23′ : 8·2, 9·2 : 309°·2 : 12″·4 : yelsh. wh., wh.

Σ **2926**. XXII^h 32^m, N 38° 16′ : 8·5, 8·5 : 336°·1 : 20″·8 : wh.

Σ **2890**. XXII^h 11^m, N 49° 16′ : 8·5, 8·7 : 11°·7 : 9″·1 : wh.

Σ **2882**. XXII^h 9^m, N 37° 8′ : 9·2, 9·2 : 326°·5 : 3″·2 : o, o.

[LACERTA]

Clusters.

4773 (H VIII 75). XXII^h 10^m, N 49° 17′. Fine cl., quickly followed by beautiful field with 3 pairs.

[7, 9. XXII^h 26^m, N 49° 40′, point out a noble field. 4, a 5 m^g. star, 1° *s p* 7, is a fine object, deep or., with bl. attendant, in rich vicinity.]

[Fine field ± XXII^h 14^m, N 45° 23′.]

LEO.

A fine constellation, the fore part of which is marked to the naked eye by a *sickle* of conspicuous stars. At the bottom of the handle, and very nearly in the pathway of the Sun, is the leader, Regulus, the Lion's Heart, the first of the list.

Double Stars.

α. X^h 2^m, N 12° 33′ flushed wh. Σ and Se think a distant 8·5 m^g. attendant, which affords a beautiful contrast, is moving with it through space. Winlock doubles *comes*, 3″·2 (Washington). Huggins finds in *α* a motion from our eye of 12 to 17 miles per second.

β. XI^h 43^m, N 15° 15′; 2·5, 8 : blsh., dull red. Very wide. Probably receding from us as δ.—Bu finds, *s* a little *p*, a close pair, 6·7, 11 : 337°·7 : 1″·5 (18½ in. achr. Chicago).

γ (Σ **1424** : 2, 3·5). X^h 13^m, N 20° 27′ : 2, 4 : 103°·2 : 2″·6, 1831 (D 110°·3 : 3″·2, 1865; De 112°·8 : 3″·3, 1877) : flushed yel., ditto paler [deeper 5½ in. 1860) : H wh., reddish wh.; K 4 cool grey grn. Σ 'rubroviridis.' Bin.; Do 407 y. Very fine object; Σ finest in N. sky. Wa in contact 2½ in. achr.—Schm thinks the neighbour, 40, var. (so Fr. Not in A).

[LEO]

ι (Σ **1536** : 3·9, 7·1). $11^h\ 18^m$, N 11° 12′ : 4, 7·5 : 87°·7 : 2″·4, 1839 (D 72°·1 : 2″·8, 1865 ; K 70°·3 : 2″·9, 1877) : pale yel., light bl. [tawny, 9 in. spec. 1870.] Fl 7·5 var., m^g. and col. Bin? [80, just divided, 1849.]

54 (Σ **1487** : 5, 7). $x^h\ 49^m$, N 25° 23′ : 4·5, 7 : 102°·7 : 6″·2 : silvery wh., ash col. Fl very slow bin.

90 (Σ **1552** : 6, 7·3). Triple. $11^h\ 28^m$, N 17° 28 : 6, 7·5, 9·5 : 209°·1, 233°·9 : 3″·5, 59″ : silvery wh., purpsh., pale red. Fl slow bin.

49 (Σ **1450** : 6, 8·7). $x^h\ 29^m$, N 9° 16′ : 6, 9 : 158°·1 : 2″·5 : silvery wh., pale bl. Fl very slow bin. 1° *s f* ρ.

6. $1x^h\ 26^m$, N 10° 15′ : 6, 9·5 : 73°·6 : 37″·6 : flushed yel., pale purp., 1851 ; [deep or., grn., $3\frac{7}{10}$ in. 1851 ; 9·5 lilac, $5\frac{1}{2}$ in. 1862 ; Fr pale or., purp., 1877.]

P XI 9 (Σ **1517** : 7·3, 7·3). $11^h\ 7^m$, N 20° 47′ : 7·5, 7·5 : 288°·6 : 1″·2, 1833 (Du 286°·8 ; 0″·6, 1875) : faint yel. Σ, OΣ, vars? Bin. C. p. m. Closely *s p* δ.

88 (Σ **1547** : 6·4, 8·4). $11^h\ 26^m$, N 15° 2′ : 7, 9 : 319°·8 : 14″·9 : topaz yel., pale lilac. Σ c. p. m.

83 (Σ **1540** : 6·3, 7·3). $11^h\ 21^m$, N 3° 40′ : 8, 9 : 150°·8 : 29″·8 : silvery wh., pale rose. Relatively fixed, c. p. m.

P X 67 (Σ **1431** : 8, 9·7). $x^h\ 19^m$, N 9° 23′ : 8, 9·5 : 64°·8 : 3″, 1831 ; 67°·5 : 3″·5, 1853 : wh., pale bl. Closely *f* 44, 6 m^g. or., which is 2° *p* ρ.

P XI 91 (Σ **3072** : 7·4, 10·4). $11^h\ 25^m$, S 6° 3′ : 8, 11 : 330°·2 : 9″·5 : creamy wh., grnsh.

P X 239 (Σ **1507** : 8·2, 10·5). $11^h\ 0^m$, N 7° 41′ : 8, 11·5 : 164°·7 : 8″·2 : topaz yel., cerul. bl. ; 11·5 very difficult, 80 ; steady, 144, so as to be a good comparative test. Wa $2\frac{1}{2}$ in. achr. Easily found ; closely *f* χ, but not quite so near it as a larger star more *n* in the field.

[LEO]

Σ 18[1] (ζ and 35). x[h] 10[m], N 24° 5′ : 3·8, 6 : 343°·1 : 314″·4 : yelsh., wh.

Σ 7[2] (93). xi[h] 42[m], N 20° 53′ : 4·7, 8·4 : 355°·5 : 74″·3 : yel., wh. [curious field ; pair repeated.]

Σ 19[1] (τ). xi[h] 22[m], N 3° 31′ : 5, 7 (P XI 71) : 169°·6 : 94″·8 : yel., wh. (Moving.)

Bu 105 (κ). ix[h] 17[m], N 26°43′ : 5, 11 : De 203°·8, 3″ : yel., bl.

Σ 1399. ix[h] 50[m], N 20° 19′ : 6·8, 7·8 : 175°·1 : 30″·1 : wh.

Σ 1527. xi[h] 13[m], N 14° 56′ : 6·9, 8·1 : 10°·1 : 3″·9 : v. wh., blsh. (Fl bin. ? 6·9 var. col. and m[g]. ?)

Σ 1529. xi[h] 13[m], S 1° 0′ : 7, 8 : 250°·9 : 9″·3 : yelsh. wh., ashy. [A fine object].

Σ 1565. xi[h] 33[m], N 19° 41′ : 7, 8 : 304°·1 : 21″·5 : wh., blsh. wh.

Σ 1448. x[h] 28[m], N 22° 12′ : 7, 9 : 258°·7 : 10″·9 : yelsh., o.

Σ 1447. x[h] 27[m], N 23° 58′ : 7·1, 8·9 : 125°·2 : 4″·3 : v. wh., blsh.

OΣ **220** (P X 85). x[h] 23[m], N 10° 45′ : 7·1, 9 : 62°·3 : 1″·3.

Σ 1355. ix[h] 21[m], N 6° 49′ : 7·2, 7·2 : 328°·3 : 2″·8 : wh.

Σ 1332. ix[h] 10[m], N 24° 8′ : 7·2, 7·5 : 16°·3 : 5″·6 : wh.

Σ 1442. x[h] 26[m], N 22° 40′ : 7·2, 7·8 : 155°·2 : 13″·3 : v. wh.

Σ 1476. x[h] 43[m], S 3° 24′ : 7·2, 8 : 353°·7 : 1″·9 : wh. (Fl bin. ?)

Σ 1360. ix[h] 24[m], N 11° 8′ : 7·4, 7·7 : 243° : 14″·3 : wh.

[LEO]

Σ **1504** (P X 229). x^h 58^m, N 4° 16′ : 7·5, 7·6 : 275°·7 : 1″·1 : wh. (Fl bin.) (In Bedford Cat. A little *f* 58.)

Σ **1500.** x^h 54^m, S 2° 48′ : 7·6, 8·2 : 331° : 1″·1 : yelsh. (Moving.)

Σ **1537.** xi^h 18^m, N 21° 17′ : 7·6, 8·6 : 356°·4 : 2″·5 : wh., ashy.

Σ **1548.** xi^h 26^m, S 2° 50′ : 7·7, 8·7 : 127°·3 : 10″·3 : o, c.

Σ **1364.** ix^h 25^m, N 20° 32′ : 7·7, 9·2 : 156°·1 : 15″·1 : wh., o.

Σ **1439.** x^h 24^m, N 21° 24′ : 8, 8·5 : 131°·4 : 2″ : wh. (Fl slow bin.)

Σ **1482** (P X 179). x^h 46^m, N 8° 7′ : 8, 8·9 : 305°·3 : 11″·7 : wh.

Σ **1389.** ix^h 46^m, N 27° 30′ : 8, 9 : 329°·2 : 1″·7 : yelsh. (Fl bin.)

Σ **1417.** x^h 9^m, N 19° 45′ : 8·2, 8·2 : 261°·4 : 2″·4 : wh.

Σ **1564.** xi^h 33^m, N 27° 37′ : 8·2, 9 : 86°·4 : 5″·1 : yelsh., o.

Σ **1429.** x^h 18^m, N 25° 12′ : 8·3, 8·3 : 270°·6 : 1″·5 : o, o. (Fl slow bin.)

Σ **1477.** x^h 43^m, N 13° 34′ : 8·3, 8·8 ; 275°·5 : 17″·6 : yelsh. wh., wh.

Σ **1419.** x^h 11^m, N 10° 44′ : 8·4, 9·1 : 223°·9 : 4″·4 : wh., blsh.

Σ **1434.** x^h 21^m, N 18° 41′ : 8·5, 8·5 : 269°·6 : 6″·1 : o, o. [Very pretty.]

Σ **1353.** ix^h 21^m, N 16° 16′ : 8·5, 8·8 : 314°·7 : 3″·1 : o, o.

Σ **1502.** x^h 56^m, N 15° 16′ : 8·5, 9·3 : 284°·5 : 12″·4 : yelsh., o.

Σ **1468.** x^h 38^m, N 21° 22′ : 8·7, 8·7 : 334°·6 : 3″·7 : v. wh.

[LEO]

Σ **3070.** $11^h\ 19^m$, S 3° 44′ : 8·8, 9·2 : 276°·3 : 8″ : o, o. (near ϕ.)

Σ **1413.** $10^h\ 6^m$, N 16° 57′ : 8·9, 8·9 : 278°·5 : 2″·4 : yelsh. wh.

Vars. [R. $11^h\ 41^m$, N 11° 59′ : 5·2, 6·4—9·4, 10 : 312^d, a little irregular : very red.[1]]

(S. $11^h\ 5^m$, N 6° 7′ : 9, 9·7—below 13 : 187^d.)

(T. $11^h\ 31^m$. N 4° 1′ : 10?—below 13 : become invisible?)

Nebulæ.

2377, 2373 (M 66, 65). $11^h\ 14^m$, N 13° 39′. Two rather faint objects, elongated in different directions, in a low-power field, with several stars. 2377, *s*, rather the larger and brighter : d'A '*magnifica*,' 6′ × 2′, the other resolved in centre. Between *ι* and *θ*, a little *f*.

2203, 2207 (H I 17, 18). $10^h\ 42^m$, N 13° 16′. Two faint neb^{se}, *p* much larger and brighter, with stellar nucleus. H a third making right-angled triangle. Sm a neat little pair *n f* [well seen, 80]. Among the neb^{se} in a round patch of 2° or 3°, in a region of few stars.

[1] Hind says, 'It is one of the most fiery-looking variables on our list—fiery in every stage from maximum to minimum, and is really a fine telescopic object in a dark sky, about the time of greatest brilliancy, when its colour forms a striking contrast with the steady white light of the 6 m. a little to the *n*.' It is one of the finest of its most mysterious class, which deserves a special investigation, in which amateurs may do good service without costly instruments. The red hue, so conspicuous in the above specimen, prevails more or less among them ; inequality or irregularity in the times of increase and decrease is common ; and some are said to be hazy, others quite sharp, at *minimum*. Baxendell has noticed a singular tendency to collection in groups.

[LEO]

1861, 1863 (H I 56, 57). $11^h\ 25^m$, N 22° 2′. Long with two nuclei [rather faint]. H equal: H and d'A *f* very faint. E. of Rosse oblique spiral, resolved.

2301 (H I 13). $x^h\ 59^m$, N 0° 37′. Large, elongated: d'A 6′ × 45″, with stellar nucleus.

(2352 (H II 49). $xi^h\ 9^m$, N 18° 46′. Small, round. Most remarkable if, as d'A thinks, var.—1831, brighter than H III 27, $1^m\ 22^s$ *f*; 1861, I class (so Schönfeld); 1863, sometimes II, at others *invisible*; 1864, not above III, and fainter than H III 27.)

LEO MINOR.

This small constellation contains several pairs and neb^{æ}, but the latter too faint for general interest. The following double stars have been selected from the Dorpat Catalogue:—

Σ **1369.** $11^h\ 28^m$, N 40° 31′: 7, 8: 147°·4: 24″·7: wh.

Σ **1374.** $11^h\ 34^m$, N 39° 30′: 7, 8·3: 274°·7: 3″·3: yelsh., v. bl. (Fl slow bin.)

Σ **1421.** $x^h\ 11^m$, N 28° 8′: 7·5, 8·5: 330°·4: 4″·4: wh., blsh.

Σ **1458.** $x^h\ 33^m$, N 32° 19′: 8, 8·2: 215°·4: 17″·7: wh.

Σ **1459.** $x^h\ 33^m$, N 39° 2′: 8, 8·5: 153°·1: 5″·2: yel., wh.

Σ **1449.** $x^h\ 28^m$, N 35° 45′: 8·5, 8·7: 289°·2: 36″: o, o.

Σ **1443.** $x^h\ 26^m$, N 38° 17′: 9, 9: 156°·3: 4″·8: o, o.

Red Star. 16. $11^h\ 42^m$, N 40° 11′: 7, var? Fr.

Var. R. $11^h\ 38^m$, N 35° 4′: 6·1, 7·5—below 11: 374^d, increase quicker than decrease.

[LEO MINOR]

Nebulæ.

1713 (H I 200). VIII^h 45^m, N 33° 53′. H calls this a very beautiful object, 8′ × 3′ : Sm saw a splendid centre [scarcely worth the search with $3\frac{7}{10}$ in., but in a very fine district, a little *p* the most *n* group of Cancer].

2104 (H I 86). X^h 21^m, N 29° 7′ : d'A very bright, oblong (E. of Rosse 6′ × 40″) with nucleus like a star 11 m^g.

LEPUS.

A little asterism under the legs of Orion; so near the horizon that it can only be well seen on the meridian, and opportunities must not be thrown away.

Double Stars.

γ. V^h 40^m, S 22° 29′ : 4, 6·5 : 349° : 92″·9 : light yel., 6·5 pale grn., 1832; flushed, 1852 [pale yel., garnet, 1851; so Sa 1874.] C. p. m. A third star, 13 m^g. : 345° : 45″ from 6·5; Gore easy, 3 in.

ι (Σ **655** : 4·2, 10·5). V^h 7^m, S 12° 1′ : 4·5, 12 : 336°·9 : 15″ : wh., pale viol. I found 12 certain, 80; a glimpse star, 144; this seems to exemplify Sm's remark, that among very minute stars, the smallest sometimes shine with a keener light than those of larger apparent magnitude.

κ (Σ **661** : 5, 7·9). V^h 8^m, S 13° 5′ : 5, 9 : 359°·5 : 3″·7 : pale wh., clear grey.

Bu **320** (β). V^h 23^m, S 20° 51′ : 3·5, 11 : De 292°·3 : 3″·1, 1877. Most rapid bin. Fl *sun and planet ?*

(P V 70. V^h 17^m, S 24° 54′ : H 6, 9·5 : O. Stone 104°·7 : 3″·5; with 3rd star near, 9 m^g.)

[LEPUS]

Σ **631.** IV^h 56^m, S 13° 41′ : 7·2, 8·7 : 104°·8 : 5″·4 : wh.

Σ **875.** VI^h 7^m, S 13° 7′ : 8·7, 9·8 : 335° : 6″. (H red, v. grn.)

Bu pair 45′ *nf* ζ (V^h 42^m, S 14° 51′) : 6, 10 : De 179°·4 : 2″·7.

About 1° 40′ *s*, a little *p*, from the following object, curious field, 3 pairs and a triplet. B.

Red Stars. [B 94. IV^h 54^m, S 14° 59′ : var. 6·7—8·5 ? 437^d.—Hind's 'Crimson Star,' 1845, described by him as 'of the most intense crimson, resembling a blood-drop on the black ground of the sky; as regards depth of colour, no other star visible in these latitudes could be compared with it.']

V^h 5^m, S 12° 10′ : 5, var. : very fine. A little *sp i*. Morton.

Es has given a list of suspected vars.—*Eng. Mech.*, Jan. 17, 1879.

Nebula and Group.

1112 (M 79). V^h 19^m, S 24° 38′. Tolerably bright with my 64, blazing in centre; higher powers show it mottled. Beautiful cl. in H$\frac{1}{2}$'s 20 f. refl., nearly 3′ diam. 4° *s* a little *p* β, closely *f* a 6 m^g. star.

[1220 (H 3780). V^h 34^m, S 17° 55′ : Brilliant group, closely *f* α. Bu *lucida* very close double. Beautiful cluster for small telescope. Gore.]

LIBRA

S. declination combines with long days and late sunsets to give trouble in looking for the objects in this constellation, which are, however, well worth the pains.

Double Stars.

β. xv^h 11^m, S 8° 56′ : 2·5. Inserted for its beautiful pale green hue, very unusual among conspicuous stars : deep green, like deep blue, is unknown to the naked eye.

α^2 and α^1. xiv^h 44^m, S 15° 33′ : 3, 6 : 314°·3 : 229″ : pale yel., light grey.

(51 Fl. See ξ Scorpii.)

P XIV 212. xiv^h 50^m, S 20° 52′ : 6, 8 : 272°·6 : 10″·3 : yel., dusky. Rapid c. p. m.

P XV 91. xv^h 25^m, S 19° 45′ : 7·5, 9, 1832 : 282°·6 : 11″·8 : blsh. wh., smalt bl. [9 very small, 1852.]

P XIV 70 (Σ **1837** : 7·1, 8·7). xiv^h 18^m, S 11° 7′ : 7·5, 9·5 : 325°·8 : 1″·6, 18.33 (Cin. 307° : 1″·4, 1877) : pale yel., grnsh. Bin. C. p. m.

P XIV 62 (Σ **1833** : 7, 7). xiv^h 16^m, S 7° 13′ : 8, 8 : 166°·8 : 5″·2 : silvery wh. $2\frac{1}{2}°$ *s f* ι Virg.

P XV 14. xv^h 8^m, S 17° 59′ : 8, 9 : 141°·7 : 48″·4 : silvery wh., 1835 (Fr redsh. 1876) : pale grey.

Bu **106** (μ). xiv^h 43^m, S 13° 39′ : 5·5, 6·3 : 333°·2 : 1″·5 ; Bu seen with $2\frac{1}{2}$ in. achr.—Triple ; 12–13 : 229°·2 : 27″·3.

Σ **1962**. xv^h 32^m, S 8° 24′ : 6·3, 6·4 : 187°·1 : 11″·8 : wh. (Fr yel., mgs. over-rated, 1876.) [A striking object.]

Bu **121** (B.A.C. 5163). xv^h 32^m, S 27° 16′ : 7, 7 : Cin. 277°·7 : 1″·6, 1879 ($\frac{1}{3}°$ *n f* 39).

Bu **35** (P XV 150). xv^h 36^m, S 15° 37′ : 7, 9·5 : De 7, 8·5 : 99°·5 : 2″·3.

Bu **117**. xiv^h 25^m, S 15° 5′ : 8, 9 : De 95°·6 : 2″·4.

Σ **1939**. xv^h 21^m, S 10° 29′ : 8, 9 : 134°·6 : 9″·3 : wh.

[LIBRA]

Bu **119**. XIV^h 59^m, S 6° 33′ : De 8, 8·5 : 313°·1 : 1″·5 (*nf* δ.)

Σ **1876**. XIV^h 40^m, S 6° 52′ : 8·1, 8·6 : 51°·7 : 1″·2 : yelsh. (Bin.)

Σ **3090**. XV^h 3^m, S 0° 31′ : 8·3, 8·7 : 275°·5 : 1″·8 : yelsh. wh.

Σ **3097**. XV^h 44^m, S 8° 40′ : 8·8, 9·2 : 181° : 4″ : o, o.

Σ **3096**. XV^h 41^m, S 4° 56′ : 9, 9 : 85°·6 : 3″·1 : o, o.

Σ **1966**. XV^h 36^m, S 10° 45′ : 9, 9 : 232°·5 : 23″·2 : o, o.—vars ?

(ι. XV^h 5^m, S 19° 20′ : 5, 9 : 110°·5 : 57″·5. Bu doubles 9—10, 10 : 24°·3 : 1″·9.)

Red Stars. P XIV 239. XIV^h 55^m, S 2° 17′ : 6 : or. red, Fr.

H 1249. XIV^h 10^m, S 15° 53′ : 8—9, 11 : larger v. red.

Vars. δ. XIV^h 55^m, S 8° 2′ : 4·9—6·1 : 2^d 7^h 51^m, increasing. Schm.

R. XV^h 47^m, S 15° 52′ : 9·2, 10—below 13 : 723^d.

S. XV^h 14^m, S 19° 57′ : 8—12·5 ? 193^d ?

Cluster.

4083 (M 5). XV^h 12^m, N 2° 32′. Beautiful assemblage of minute stars (H 11–15 m^g.), greatly compressed in centre. M saw none. ℍ about 200 with 40 f. reflector. E. of Rosse curved exterior branches, seen also by Buffham with 9 in. mirror. Closely *n p* 5 Serp. 5 m^g.

LYNX.

A troublesome constellation, excepting with an equatorial mounting, as there are few conspicuous leaders among a number of tolerably considerable stars, which are puzzling in the finder. The beauty of its pairs will, however, reward a persevering observer.

Double Stars.

38 (Σ **1334** : 4, 6·7). IX^h 11^m, N 37° 19′ : 4, 7·5 : 241°·6 : 2″·8 : silvery wh., 1832 (Fr pale yel. 1877), lilac. C. p. m.

14 (Σ **963** : 5·9, 7·1). VI^h 43^m, N 59° 35′ : 5·5, 7 : 50° : 1″, 1833 (Gl 64°·1 : 0″·7, 1875) : golden yel., purple. Divided by Buffham, 9 in. spec. 7 grn. 1869. Fl rapid bin. [not examined.]

12 (Σ **948** : 5·2, 6·1, 7·4). Triple. VI^h 36^m, N 59° 34′ : 6, 6·5, 7·5 : 154°·3, 305°·1 : 1″·6, 8″·6, 1832 (Gl 130° : 1″·4, 1876) : wh., ruddy, blsh., 1832, 1839, 1852 [7·5 ruddy, 1854 (so Hunt, 1863) : elongated, 80; divided at times, 144]. Bin., period perhaps 700 y. Fl ternary.

P VI 301 (Σ **1009** : 6·7, 6·8). VI^h 56^m, N 52° 56′ : 6, 6·5, 1843; 159°·4 : 3″ : wh. [little diff. in m^g. 1852.—so Σ 1830, and Fr 1877].

4 (Σ **881** : 6·4, 7·9). VI^h 11^m, N 59° 25′ : 6, 7·5 : 90°·2 : 1″, 1837 (De wedged, 1856) : wh. Bin. [not examined.]

41. IX^h 21^m, N 46° 8′ : 6·5, 8·5 : 160°·8 : 86″·8 : blsh., 1832 [deep yel., lilac, 1852]. Sm thinks P's 6·5 underrated. A 10 m^g. star forms a triangle.

39 (Σ **1340** : 6·5, 8·3). IX^h 14^m, N 50° 3′ : 6·5, 9, 1839 (Main 4, 7·5, 1863) : 319°·5 : 6″·2 : lucid wh., sapph. bl. 2½° *s p θ* Urs. Maj.

19 (Σ **1062** : 5·3, 6·6). Triple. VII^h 13^m, N 55° 30′ : 7, 8, 8 : 312°·4, 358°·2 : 14″·6, 215″ : wh., two plum coloured.

20 (Σ **1065** : 6·6, 6·8). VII^h 13^m, N 50° 22′ : 7·5, 7·5 : 253°·3 : 15″·2 : silvery wh.

P VI 174 (Σ **946** : 7·2, 9). VI^h 34^m, N 59° 34′ : 7·5, 10 : 134°·2 : 4″ : bright wh., bl. Σ thinks 10 var. and this, Sm observes, 'awakens considerations of peculiar

interest, it having been surmised that certain small acolyte stars shine by reflected light.' Exactly *p* 12.

P VI 215 (Σ **960** : 7·3, 9·2). VI^h 40^m, N 53° 9′ : 8, 11 : 69°·1 : 23″ : bright yel., dusky grn. [not found.]

P VIII 131 (Σ **1258** : 7·1, 7·4). VIII^h 35^m, N 49° 18′ : 8·5, 8·5 : 331°·5 : 9″·8 : wh. About 2° *n p* ι Urs. Maj.

Σ **958.** VI^h 38^m, N 55° 52′ : 6, 6 : 256°·7 : 5″·1 : wh. 1830 [yel. 1852, 1857. Easy, naked eye; furthest E. of scattered group].

OΣ **174.** VII^h 28^m, N 43° 17′ : 6·5, 8·1 : 84°·3 : 2″.

Σ **1333.** IX^h 11^m, N 35° 52′ : 6·6, 6·9 : 39°·4 : 1″·4 : v. wh. (*n p* α : naked eye star from combined impression.)

Σ **1282.** VIII^h 43^m, N 35° 29′ : 7, 7 : 277°·4 : 3″·4 : yelsh. wh., v. wh.

Σ **1338.** IX^h 13^m, N 38° 42′; 7, 7·2 : 121°·1 : 1″·8 : wh. 1829. (Du 151°·8 : 1″·6, 1876. Bin.)

Σ **1234.** VIII^h 24^m, N 55° 45′ : 7, 8·3 : 71°·3 : 20″·8 : yel., o.

Σ **936.** VI^h 29^m, N 58° 12′ : 7, 8·7 : 254°·9 : 1″·6 : yel., bl. (Fl bin ?)

Σ **1274.** VIII^h 41^m, N 38° 47′ : 7, 8·7 : 40°·8 : 8″·9 : v. wh., ash.

Σ **1187.** VIII^h 2^m, N 32° 35′ : 7·1, 8 : 71° : 1″·6 : wh. 1829. (Gl 52°·8 : 1″·9, 1874—Fl bin.)

Σ **1001.** VI^h 54^m, N 54° 23′ : 7·1, 8·7 : 64° : 8″·9 : gold, o.—Triple; 9 : 354°·8 : 1″·7.

Σ **1050.** VII^h 10^m, N 55° 9′ : 7·3, 8 : 19°·2 : 19″·4 : wh.

Σ **1033.** VII^h 5^m, N 52° 47′ : 7·4, 8 : 282° : 1′·4 : v. wh.

Σ **1025.** VII^h 3^m, N 56° 0′ : 7·5, 7·8 : 141°·2 : 22″·7 : wh.

Σ **1086.** VII^h 20^m, N 43° 0′ : 7·5, 9 : 102°·3 : 12″·2 : v. yel., o.

[LYNX]

Σ **1263.** VIIIh 37m, N 42° 8′ : 7·6, 8·2 : 359° : 4″·9, 1828 (Fl 18°·9 : 38″·9, 1877) : yelsh. wh., wh. (Rapid but not orbital motion.)

Σ **1289.** VIIIh 47m, N 44° 2′ : 7·7, 8·5 : 4°·2 : 3″·8 : wh.

Σ **866.** VIh 7m, N 62° 14′ : 7·7, 8·8 : 193°·4 : 17″·8 : wh.—Triple ; 8·2 : 264°·7 : 78″·8 : wh.

Σ **3120.** VIIIh 48m, N 44° 7′ : 7·8, 8·8 : 348°·1 : 1″·5 : yelsh., wh.

Σ **1256.** VIIIh 34m, N 49° 44′ : 7·8, 9·3 : 212°·3 : 25″·5 : yelsh., o.

Σ **1174.** VIIh 56m, N 47° 37′ : 8, 8·5 : 215° : 5″·7 : wh.

Σ **1184.** VIIIh 1m, N 38° 13′ : 8, 8·5 : 340°·4 : 27″·1 : yelsh. wh., wh.

Σ **1204.** VIIIh 8m, N 38° 51′ : 8, 9 : 103°·9 : 11″·8 : o, o.

Σ **1222.** VIIIh 19m, N 37° 56′ : 8, 9 : 46°·6 : 10″ : wh.

Σ **968.** VIh 43m, N 52° 48′ : 8, 9 : 287°·3 : 20″·6 : wh.

Σ **935.** VIh 29m, N 52° 23′ : 8·2, 9 : 322°·2 : 3″·4 : wh.

Σ **1225.** VIIIh 21m, N 51° 35′ : 8·5, 8·5 : 194°·2 : 3″·5 : wh.

Σ **1200.** VIIIh 7m, N 50° 8′ : 8·5, 8·5 : 0°·7 : 8″·4 : wh.

Σ **1044.** VIIh 8m, N 47° 53′ : 8·5, 8·7 : 167°·2 : 12″·4 : o, o.

Σ **1296.** VIIIh 52m, N 35° 25′ : 8·5, 9 : 71°·2 : 2″·8 : o, o. (Bin ?)

Σ **1259.** VIIIh 39m, N 38° 54′ : 8·5, 9 : 340°·9 : 5″ : wh.

Σ **1002.** VIh 54m, N 56° 37′ : 8·5, 9 : 316°·6 : 30″·2 : o, o.

Σ **1344.** IXh 16m, N 39° 39′ : 8·5, 9·2 : 106°·6 : 3″·6 : wh.

Σ **1242.** VIIIh 28m, N 47° 31′ : 8·6, 9·3 : 170°·5 : 2″·5 : wh.

Σ **1211.** VIIIh 10m, N 39° 21′ : 8·7, 9·2 : 132°·7 : 1″·6 : wh.

[*a* (40). IXh 14m, N 34° 54′ : 4 : or. has 8 or 9 ms. attendant, viol. (Σ **1342** : 8·6, 11 : 326°·9 : 17″·9.) Sm single.]

Red Star. B.A.C. 2798. VIIIh 16m, N 42° 24′ : 6 : or. red, with companion est. 8 : 160° : 60″ : fine bl. Fr. (OΣ² **93**).

[LYNX]

Var. R. VI^h 51^m, N 55° 31′ : 9 ?—below 12·3 : period unknown.

LYRA.

For its size, one of the most remarkable constellations, full of beautiful fields, and adorned by one of the great leaders of the firmament,—the first of the following list.

Double Stars.

α (Wega), XVIII^h 33^m, N. 38° 40′, to my sight is inferior to Sirius only. $\frac{H}{G}$ and H have ranked Arcturus and Capella higher: probably differences of colour affect materially the estimates which different eyes form of magnitude:[1] a supposition entertained by Sm as well as by other great observers. Wollaston's experiments, from which he allowed Wega but $\frac{1}{9}$ of the light of Sirius, must surely have involved some fallacy. Humboldt thought it twinkled less than Arcturus and Procyon. Its colour is pale sapphire,—a lovely gem: its enormous real bulk is evident from its very minute and doubtful parallax, giving perhaps 18 y. of light-passage. Huggins thinks that it is approaching us at 44 to 54 miles per second. A smalt-bl. 11 m^g. attendant—135°·2 : 43″, 1830; K 151°·9 : 46″, 1865—is a well-known test: my $3\frac{7}{10}$ in. sometimes showed it in favourable weather: I have thought it easier with 80 than 144; De thinks it brighter than formerly: it must be looked for very near the rays of *α*, as there are other very minute stars at greater distances in the field. It has been detected by Erck with $2\frac{1}{10}$ in. of a $7\frac{1}{2}$ in. achr., glimpsed by Wa with $1\frac{6}{10}$ in. of $4\frac{3}{10}$ in. achr.,

[1] The American astronomers at Harvard College, with the great 22 f. achr., have found that Wega surpasses Arcturus in photographic power no less than 7 times: no doubt from its different hue.

and seen with an 8½ in. 'With' mirror less than 30^{m} after sunset. Buckingham and others, with 9 and 21¼ in. apertures, have seen 3 other closer and fainter *comites*. Winnecke one, Bu 292°: 51″·8. Penrose one, 5½ in. achr. De La Rue one often suspected. Buckingham thinks them var. They have not been seen with the great telescopes at Chicago and Washington.—6^{m} *p*, 5′ *s* is Σ **2338**, triple: 8·5 (yelsh.), 9·7, 8: 300°·5, 209°·1: 13″·4, 77″·1.

β (Σ 39 App. I: 3, 6·7). XVIII^{h} 46^{m}, N 33° 13′. Var. 3·4 to 4·5 m^{g}. in about 12^{d} 21^{h} 47^{m}, two maxima and two unequal minima occurring within that time, in which Schm has recently detected minor variations: its three companions, 8, 8·5, 9, with a minute neat pair, make up a fine field. Sm, 1834, marked β 'very wh. and splendid;' I found it, 1849, 1850, 1855, decidedly yellower than γ, which he calls at the same epoch bright yel.; H and South call it wh., 1824; Mädler pure wh.; Σ flava, 1835; Main yel. 1862. γ, on the contrary, I saw wh., or very pale yel., 1850, 1855; 5½ in. showed both very pale, but β the yellower, 1862; Schm made them both whitish yel., 1844–1855. Se found (1866) in β (but with much difficulty) a spectrum like that of γ Cass., which subsequently disappeared. γ is a suspected var., being brighter than β. It has 3 extremely faint attendants.

ζ (Σ 38 App. I: 4·2, 5·5). XVIII^{h} 41^{m}, N 37° 29′: 5, 5·5, 1834 [more unequal, 3$\frac{7}{10}$ in. 1850, 1855; as Sm, 5½ in. 1862]: 149°·6: 43″·8: topaz, grnsh. Fr 5, 6, 1876–7: pale yel., lilac. Plummer 4, 6·5, 1876.

ε^{1}, ε^{2} (4, 5) (Σ **2382**, **2383**, 37 App. I: 4·0, 6·3; 4·9, 5·2). Double-double. XVIII^{h} 40^{m}, N 39° 33′: 5, 6·5 and 5, 5·5: 21°·9: 3″·3 and 152°·8: 2″·5, 1839; 19°·7: 3″ and 148°·1: 2″·5, 1853: yel., ruddy; and both wh. 'The

[LYRA]

naked eye,' Sm observes, 'sees an irregular-looking star near Wega, which separates into two pretty wide ones under the slightest optical aid. Each of these two will be found to be a fine binary pair.' So I see it, and probably most observers: ⊞, however, Bessel at 13 years of age, and many others have divided it with the naked eye. The distance is 3′ 27″. Little doubt of the rotation of each pair, ϵ^1 perhaps in about 2000 y., ϵ^2 in half that time, and possibly both pairs round their common centre of gravity in something less than a million y. Between them lie three much smaller ones; one, 9·5 m (D), obvious; two,—the *debilissima* of H,—excessively minute,[1] 13 mg., on each side of the line joining ϵ^1 and ϵ^2: in very fine weather I have had glimpses of one, and suspicions of the other, with $3\frac{7}{10}$ in.—an aperture for which they are excellent tests. In very fine air Wa has seen them with $2\frac{1}{8}$ in. achr. Grover has found them alternately var.; so Squire and Fr, who has seen a little star *p* brighter than either. There are about 6 or 7 other extremely faint points in the group, some of them very difficult tests, though Holden has seen several with 3 in. achr. Σ surmised alternately variable light in the components of ϵ^2; and saw 6·5 of ϵ^1 blsh.; so De and Fr. This most beautiful object, which I have seen well with $2\frac{1}{4}$ in., lies $1\frac{1}{2}°$ *n f a*.

η (Σ **2487**: 4, 8·1). XIX^h 10^m, N 38° 56′: 5, 9: 84°·8: 28″·3: sky-bl., viol., 1834; [yel., grnsh. or blsh., in my own $3\frac{7}{10}$ in. and Bishop's 7 in. achr. 1849–50; 5 pale yel., $5\frac{1}{2}$ in. 1862; Σ bl., 1830. Main as Sm, 1861; Fr yelsh. wh., indigo, 1879. A low-power field includes 2 other small pairs, *s p*, and *f*; B adds a third.]

17 (Σ **2461**: 5·7, 9·8). XIX^h 3^m, N 32° 19′: 6, 11:

[1] This was, presumably, H's meaning; not the faintest possible objects, as may have sometimes been supposed.

[LYRA]

329°·9 : 3″·6 : light yel., cerul. bl., 1836; Wilson and Seabroke missed 11, 1873; 321°·9, 1876. C. p. m. [About $2\frac{1}{4}°$ *n* are 2 wide pairs in a large sprinkled field.]

P XVIII 151 (Σ **2362** : 7·1, 8·4). XVIII^h 34^m, N 35° 57′ : 8, 9 : 180°·2 : 3″·8 : pale wh., lilac.

P XIX 13 (Σ **2472, 2473** : 7·5, 9·2; 9, 9·2). Quadr. XIX^h 4^m, N 37° 43′ : 8, 11, 9·5, 12 : 337°, 350° : 18″·5, 74″·8 (9·5, 12 : 294° : 5″) : bright yel., pale grey, grnsh., dusky. 12 var.? should be watched; Hunt nearly equal, 1868; Sa 0·5 less than 8·5, 1874. A very minute star between the pairs. Sa several other minute *comites*.

Σ **2349**. XVIII^h 32^m, N 33° 21′ : 5·5, 10·7 : 205°·5 : 7″·3 : blsh. wh., o. (Wa minute *comes*.)

Σ **2474**. XIX^h 5^m, N 34° 25′ : 6·7, 8 : 258°·7 : 17″·3 : yelsh., ashy.

Σ **2470**. XIX^h 4^m, N 34° 34′ : 6·7, 8·2 : 271°·6 : 12″·9 : wh.

Σ **2372**. XVIII^h 38^m, N 34° 39′ : 6·7, 8·2 : 84°·2 : 25″·1 : wh., blsh. (D triple, 12.)

Σ **2380**. XVIII^h 39^m, N 44° 51′ : 6·7, 8·2 : 10°·2 : 25″·8 : yel., blsh. wh.

OΣ **371**. XIX^h 11^m, N 27° 14′ : 6·8, 6·9 : 154°·1 : 0″·8. —Triple; 9 : 267°·8 : 47″·8.

Σ **2367**. XVIII^h 36^m, N 30° 11′ : 7, 8·4 : 193°·9 : 14″·1 : yel., blsh.—7 very closely double, 7·5 : 68°·3 : 0″·4.

Σ **2483**. XIX^h 8^m, N 30° 9′ : 7·2, 8·3 : 319° : 9″·7 : wh.—Triple; 8·5 : 237° : 71″·1 : wh.

Σ **2397**. XVIII^h 42^m, N 31° 17′ : 7·2, 9·5 : 267°·4 : 3″·7 : yel., bl.

Σ **2390**. XVIII^h 41^m, N 34° 23′ : 7·3, 8·7 : 157°·9 : 4″·2 : wh., o.

[LYRA]

Σ **2393.** XVIII^h 41^m, N 38° 13′ : 7·3, 10 : 22°·5 : 10″·4 : red, o. (Es 10 v. bl.—1^m *f*, 1° 18′ *s*, from *ε*.)

Σ **2351.** XVIII^h 32^m, N 41° 13′ : 7·4, 7·4 : 339°·8 : 5″·2 : wh. [Minute, but pretty.]

Σ **2469** (P XIX 8). XIX^h 4^m, N 38° 43′ : 7·6, 8·7 : 120°·9 : 1″·3 : wh.

Σ **2376.** XVIII^h 39^m, N 30° 18′ : 7·7, 8·4 : 63°·8 : 22″·3 : wh.

Σ **2441.** XVIII^h 58^m, N 31° 15′ : 7·7, 9·3 : 291°·9 : 5″·2 : yelsh., o. (Bin.?)

Σ **2491.** XIX^h 11^m, N 28° 6′ : 7·9, 9·2 : 206°·7 : 1″·1 : o, o. (Moving.)

Σ **2481.** XIX^h 7^m, N 38° 34′ : 8, 8 : 234°·3 : 3″·8 : yelsh. wh. (Se triple; 9 : De 69°·8 : 0″·4. Ternary.) 2^m 42^s *p*, 23′*s* , from *η*.)

Σ **2328.** XVIII^h 25^m, N 29° 53′ : 8, 8·3 : 73° : 3″·4 : wh.

Σ **2466.** XIX^h 3^m, N 29° 38′ : 8, 8·5 : 109°·3 : 2″·3 : v. wh.

Σ **2505.** XIX^h 16^m, N 35° 19′ : 8, 8·7 : 314°·9 : 9″·9 : yel., bl.

Σ **2356.** XVIII^h 34^m, N 28° 36′ : 8, 9 : 47°·1 : 1″ : yel., yelsh. (Moving.)

Σ **2448.** XVIII^h 59^m, N 35° 31′ : 8·2, 8·2 : 193°·2 : 2″·4 : yelsh. wh.

Σ **2456.** XIX^h 2^m, N 38° 19′ : 8·2, 8·2 : 13°·6 : 29″·1 : wh. (Moving.)

Σ **2459.** XIX^h 2^m, N 25° 47′ : 8·4, 9·1 : 233° : 13″·7 : wh.

Σ **2430.** XVIII^h 55^m, N 29° 29′ : 8·5, 8·5 : 359°·3 : 1″·9 : v. wh.

Bu **421.** XVIII^h 48^m, N 43° 15′ : 8·5, 9 : est. 270° : 1″, —Triple; 9 : 230° : 30″.

[LYRA]

Σ **2458.** XIX^h 2^m, N 27° 35′ : 8·5, 9 : 227°·7 : 10″·9 : o, o.—Triple ; 7·5 : 244°·3 : 70″·4.

Σ **2427.** XVIII^h 54^m, N 38° 6′ : 8·5, 9 : 63°·6 : 44″·2 : o, o.—Triple ; 9·2 : 80°·1 : 6″·9 (from 9). [In interesting group.]

Σ **2467.** XIX^h 3^m, N 30° 37′ : 8·6, 9 : 263° : 10″·1 : o, o.

Σ **2419.** XVIII^h 51^m, N 29° 6′ : 8·7, 8·8 : 179°·5 : 3″·2 : v. wh.

Σ **2394.** XVIII^h 41^m, N 41° 57′ : 8·7, 9·2 : 201°·5 : 6″·6 : yelsh., o.

Σ **2358.** XVIII^h 34^m, N 30° 37′ : 8·8, 9 : 216°·5 : 2″·6 : o, o.

[δ^2 and δ^1. XVIII^h 50^m, N 36° 49′ : 4, 5 ; Fr 5, 6, 1877 ; fine or., wh. Heis double to naked eye. Glorious field for low powers.] 17^s *p* δ^1, 24′ *n* is Bu **137** ; De 8·2, 8·7 : 123°·8 : 1″·2.

[*θ*. XIX^h 12^m, N 37° 55′ : 5, 10 : yel., bl., is in a fine field.]

[B. A. C. 6468. XVIII^h 50^m, N 33° 49′ : A 7, 8·7 : OΣ 5·1, 7·1 ; Heis naked eye : K 350°·2 : 45″ : deep yel., bl. ; beautiful miniature of *β* Cyg., with 2 minute companions. 7 is OΣ **525**. D 5, 11 : 124°·5 : 1″·9 ; he calls 11 most difficult to measure, and nearly *min. vis.* of his 6½ in. achr. OΣ, who gives 10·3, thinks it var., as De makes it 8 and 9. I held it pretty steadily with 9½ in. spec.—A little *sf* is Σ **2421**, 8, 8·7 : 68°·8 : 21″·1 : wh.]

Red Stars. [B 448. XVIII^h 28^m, N 36° 54′ : 8·5 var.? : deep crimson. B.]

[B 458. XVIII^h 39^m, N 36° 51′ : Webb 9 : A 7·5 ; B 8–8·5.]

B. A. C. 6624. XIX^h 15^m, N 40° 9′ : 7·5 var.? : or. red. Fr.

Var. R. XVIII^h 52^m, N 43° 48′ : 4·3—4·6 : 46^d : red.

Nebula, Cluster, and Groups.

4447 (M 57). XVIII^h 49^m, N 32° 53′. The only annular neb. accessible by common telescopes; fortunately easily found $\frac{1}{3}$ of the distance from β towards γ. It is somewhat oval, and bears magnifying well: its light I have often imagined fluctuating and unsteady, like that of some other plan. neb^{se}: an illusion arising probably from an aperture too small for the object. Schr and Harding found variable patches in it, 1797–8. E. of Rosse thought it resolvable, and saw several wisps or appendages within and without it. d'A perceived *n p* edge brightest, and two small stars there. No stars are traceable with the 18½ and 26 in. American achrs.; yet Se reduced it to minute stars, glittering like finely powdered silver, and Chacornac also resolved it with the great Foucault silvered mirror of 2½ f. Nevertheless the spectroscope of Huggins finds nothing but luminous gas. But in how strange a form, and how marvellously preserved in incandescence! Nor can we so much as conjecture its distance or magnitude.—Minute star *f*; H 11 m^g., d'A certainly only 14, 1861 ? Yet Sa caught it with 3 in. achr. 1874.

4485 (M 56). XIX^h 12^m, N 29° 58′. Faintish, perhaps resolvable with $3\frac{7}{10}$ in. in fine field and rich region, between 3° and 4° *n p* β Cyg. Sm 'a globular cluster in a splendid field:' H 11–14 m^g. Strange contrast to the last.

[Pretty group, ± XVIII^h 53^m, N 38° 5′.]

[Bright broad group, ± XVIII^h 51^m, N 42°.]

[Curious grouping of small open pairs and triplets, ½° to ¾° *n p* ϵ.]

[Triplet, ± XVIII^h 44^m, N 28° 21′.]

[Sweeping between Lyra and Cygnus exceedingly fine.]

MONOCEROS.

Inconspicuous to the naked eye, but rich in groups and clusters from including a brilliant part of the Galaxy.

Double Stars.

8 (Σ **900** : 4, 6·7). VI^h 18^m, N 4° 39′ : 5·5, 8 : 23°·8 : 12″·9 : gold yel., lilac. B faint *comes*, est. 12 : 50° : 60–70″. Sa est. 35° : 90″ ; between 2 minuter stars. Glorious low-power field.

29 (Σ **1190** : 6, 11·7). Triple. VIII^h 3^m, S 2° 38′ : 5·5, 13, 9 : 104°·7, 243°·8 : 30″, 66″·9 : light yel., grey, pale bl. 13 more like 10 or 11 to me, 1851, 1855, 1856, 1872 (9 in. spec.) ; Gore 3 in. achr. 1874 ; Sa 10, 1875 ; Fr 11, 1877; yet H and South missed it. Σ saw it in a 5 f. instrument. Var.? Rich vicinity.

15 (Σ **950** : 6, 8·8). VI^h 34^m, N 10° 0′ : 6 (var. S), 9·5 : 206°·2 : 2″·5 : grnsh., pale grey. Fl very slow bin. A blue *comes* 15 m^g., which I held well with 5½ in. 1864 (like 12 or 13 m^g. 9 in. spec. 1872). I found one still smaller and more remote with 5½ in. *n p.* D had measured these. Three other pairs in an irregular transverse line above. One De 9·5, 10 : 47° : 3″·9.—Fine group *s*.

11 (Σ **919** : 5, 5·5, 6). Triple. VI^h 23^m, S 6° 57′ : 6·5, 7, 8 : 130°·3, 121°·6 : 7″·2, 9″·6 (7 and 8, 102°·3 : 2″·8, 1834 ; Du 105° : 2″·3, 1871) : wh. 1834 (Hunt 6·5 or. 1862 ; so Sa 1875), two pale wh. H, the discoverer in 1781, calls this 'one of the most beautiful sights in the heavens.' Striking appearance of connection, yet very stationary. Fr a naked eye star. Sa *comes* 15 m^g. est. 290° : 85″. Bu does not mention this, but one 56°·1 : 25″·8.

P VII 116 (Σ **1097** : 6·5, 8·7). VII^h 22^m, S 11° 19′; 7

[MONOCEROS]

(Heis 6), 9·5 : 315° : 20″ : yel., viol. 14 mg. star *s*, clear bl. Bu 7 double; De 6·3, 8·2 : 166°·3 : 0″·8. 9·5 minute *comes*, est. 305° : 12″.

P VIII 81 (Σ **1233** : 7·2, 11·5). VIIIh 22m, S 2° 7′ : 7, 11 : 325° : 15″ : pale topaz, viol. Es 11 var.?

P VI 104, 105. VIh 21m, N 0° 32′ : 7·5, 8·5 : 151°·5 : 67″·8 : topaz yel., plum coloured. Σ divides, Sm elongates 8·5 (Σ **910** : 8·3, 8·8). De 0″·7. Fl slow bin. A low-power field includes 77 Or., a fine 6 mg. yel. star, with this pair *n p*, and another *s p*: a noble spectacle.

Σ **1183.** VIIIh 1m, S 8° 54′ : 5·5, 7·8 : 326°·3 : 31″ : yelsh. wh., wh.

Σ **921.** VIh 24m, N 11° 22′ : 6, 8·2 : 3°·8 : 16″·3 : yelsh. wh., blsh. wh.

Σ **914.** VIh 21m, S 7° 25′ : 6·7, 9 : 297°·6 : 21″ : v. wh., o. (2m 18s *p*, 29′ *s*, from 11.)

Σ **926.** VIh 25m, N 5° 54′ : 7·3, 8·7 : 287°·1 : 10″·7 : yelsh. wh., ash.

Σ **1029.** VIIh 2m, S 4° 27′ : 7·4, 8·1 : 23°·4 : 2″·1 : v. wh.

Σ **953.** VIh 34m, N 9° 7′ : 7·5, 8 : 330°·9 : 7″·1 : yelsh. blsh.

Σ **869.** VIh 5m, S 9° 49′ : 7·5, 8·5 : 279° : 24″·3 : wh., o.

Σ **987.** VIh 48m, S 5° 41′ : 7·7, 7·8 : 163°·5 : 1″·1 : o, o.

Σ **901.** VIh 18m, N 10° 35′ : 7·7, 9·5 : 247°·5 : 20″ : wh., o.

Σ **1056.** VIIh 9m, S 1° 39′ : 7·8, 8·8 : 297°·9 : 4″ : yelsh., blsh.

Σ **1010.** VIh 55m, S 2° 55′ : 7·8, 8·8 : 4°·5 : 23″·7 : wh.

Σ **1045.** VIIh 7m, S 2° 58′ : 7·8, 9 : 226°·9 : 5″·9 wh., ash.

Σ **1157.** VIIh 49m, S 2° 28′ : 8, 8 : 267°·3 : 1″·6 : wh.

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(Moving.—A little *s p* is Σ **1154** : 7·7, 9·9 : 358° : 2″·3 : wh., purpsh.; and further on, Σ **1152**: 8·2, 9·9 : 312°·9 : 5″·8 : yel.)

Bu **327.** VI^h 52^m, S 2° 52′ : De 7·5, 8 : 100°·1 : 1″.—Triple; 11·5 : 102°·6 : 13″·2.

Σ **1141.** VII^h 41^m, N 0° 18′ : 8, 8·7 : 8°·9 : 17″·7 : wh. [In pretty group.]

Bu **323.** VI^h 9^m, S 1° 41′ : De 8·5, 10·2 : 96°·2 : 2″·4.

Σ **915.** VI^h 22^m, N 5° 21′ : 8, 9 : 39°·1 : 5″·9 : wh.

Σ **1030.** VII^h 3^m, S 8° 31′ : 8, 9·2 : 42° : 15″·7 : yelsh., o.

Σ **1132.** VII^h 36^m, S 3° 15′ : 8·1, 8·7 : 237°·9 : 19″·3 : wh.

Σ **939.** VI^h 29^m, N 5° 25′ : 8·1, 8·7 : 106°·2 : 29″·8 : o, o.—Triple; 9 : 49°·3 : 39″·8. [Beautiful.]

Σ **998.** VI^h 51^m, S 5° 21′ : 8·2, 8·5 : 205°·5 : 3″·1 : wh.

Σ **1111.** VII^h 26^m, S 8° 27′ : 8·2, 8·7 : 219°·6 : 19″·8 : yelsh., wh.

Σ **986.** VI^h 48^m, N 9° 41′ : 8·3, 8·8 : 167°·2 : 5″·2 : v. wh.

Σ **898.** VI^h 15^m, N 11° 2′ : 8·3, 8·8 : 121° : 6″·1 : wh.

Σ **1015.** VI^h 59^m, S 5° 35′ : 8·7, 8·7 : 195°·6 : 4″·9 : wh.

Σ **1052.** VII^h 9^m, S 10° 5′ : 8·5, 8·7 : 20°·3 : 20″ : wh.

Σ **949.** VI^h 34^m, N 5° 50′ : 8·5, 9 : 287°·7 : 3″·4 : wh.

Σ **1034.** VII^h 4^m, S 8° 7′ : 8·7, 9·2 : 17°·6 : 2″·5 : o, o.

Σ **1043.** VII^h 7^m, S 0° 28′ : 8·8, 8·8 : 248°·3 : 2″·4 : wh.

Σ **1109.** VII^h 26^m, S 0° 16′ : 8·8, 8·8 : 15°·1 : 3″·4 : wh.—Triple; 11 : 303°·6 : 27″·1.

Σ **1264.** VIII^h 36^m, S 7° 58′ : 9, 9 : 269°·7 : 5″·8 : o, o.

Σ **952.** VI^h 34^m, N 10° 3′ : 9, 9 : 295°·2 : 13″·6 : o, o.

Σ **1003.** VI^h 53^m, S 9° 0′ : 9, 9·2 : 320°·3 : 3″·9 : o, o.

Σ **3118.** VI^h 35^m, N 9° 55′ : 9, 9·5 : 174°·8 : 2″·4 : o. (Fl bin.?)

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Σ 1077. VII^h 15^m, S 0° 28′ : 9·3, 9·3 : 322°·2 : 5″·4 : 0, 0.

(3. V^h 56^m, S 10° 36′ : Bu 5·5, 10; K 356°·1 : 1″·8.)

(5. VI^h 9^m, S 6° 14′ : 4·5 : or., has *comes*, H, 18 : est. 30° : 35″; Sa easy, 6½ in. spec.)

[31 (P VIII 152). VIII^h 38^m, S 6° 48′ : 5·5, 8 (S. D. U. K. Map, 7, 9; A 5) : fine yel., beautiful bl.]

(4. VI^h 3^m, S 11° 8 : Bu 6, 11; K 178°·6 : 3″·4 : pale yel., bl., with second *comes* 11·5 : 244°·1 : est. 10″.)

[Red Star. B 165. VII^h 1^m, S 7° 23′ : 8.]

Vars. R. VI^h 32^m, N 8° 52′ : 9·5—11·5 : Irregular. At *s* end of neb. (H 399) like a comet.

S. VI^h 34^m, N 10° 0′ : 4·9—5·4. Irregular. This is F 15 *antea*.

T. VI^h 19^m, N 7° 9′ : 6·2—7·6 : 26^d.

A list of suspected vars. in Monoceros has been given by Es in *Engl. Mech.*, January 17, 1879.

Clusters.

1424 (ℍ VII 2). VI^h 25^m, N 4° 57′. Beautiful; visible to the naked eye; including 12, 6 m^g. yel.; and many 7 and 8 m^g. stars: the smallest (14 m^g.) run in rays. [Small pair near centre.]

1483 (M 50). VI^h 57^m, S 8° 10′. Brilliant cl. straggling, H says, to 30′; between Sirius and Procyon, ⅓ nearer the former, in a superb neighbourhood, where the Creator has

'—— sowed with stars the heaven thick as a field.'[1]

1465 (ℍ VI 27). VI^h 46^m, N 0° 36′. Bright Galaxy cl. resembling three arms of a cross.

1637 (ℍ VI 22). VIII^h 8^m, S 5° 26′. Group of pretty uniform 9 m^g. stars, with a profusion of lesser ones.

[1] Milton.

[MONOCEROS]

1415 (10). VI^{h} 22^{m}, S 4° 41′. This 6 m^{g}. pale yel. star is the *lucida* of an elegant group, visible with naked eye: and the Galaxy throughout this constellation well repays the trouble of sweeping.

OPHIUCHUS.

An extensive region, somewhat barren to the eye, but attractive to the telescope.

Double Stars.

λ (Σ **2055** : 4, 6·1). XVI^{h} 25^{m}, N 2° 15′ : 4, 6 : 351°·2 : 1″, 1834 (De 25°·3 : 1″·5, 1865; 36° : 1″·6, 1877) : yelsh. wh., smalt bl.; D 6 wh., grnsh. wh., deep yel., pale yel. Other observers give very discordant tints (Es, Fr cols. var.!) Sa 2 faint *comites*. Beautiful bin.; Do 234 y.

67. XVII^{h} 55^{m}, N 2° 56′ : 4, 8 : 143°·6 : 54·7″ : straw-col., purple. B faint pair *s p*. (At a short distance *p*, a little *s*, must be H's 'very fine or. star,' 7·5 m^{g}.)

36. XVII^{h} 8^{m}, S 26° 25′ : 4·5, 6·5 : 226°·1 : 5″·2, 1831; 213°·8 : 4″·6, 1857 (Fl 203°·1 : 4″·3, 1877) : ruddy, pale yel., 1831, 1835, 1839, 1842 [gold. yel., 1854, 6·5 rather deeper?]. Sm says 'the principal star is thought to be var., though I have always seen it as now registered.' H 6, 6, 1834, 1837; D 5, 5, 1841; so Jacob, 1846. [1854, nearly equal, about 6·5, Sm's smaller perhaps rather the larger.] A 7·5 m^{g}. star lies near it. 36 is in orbital movement, with a period of perhaps 200 y. (?), and also, strange to say, has the same rapid prop. mot.—1″·27 annually—with 30 Scorp. more than 13′ distant, so as to lead to the impression that, in Sm's words, 'while in itself a singular revolving binary system, it is accompanying another and a most distant object in an *annus magnus*, to contemplate the period of which

makes imagination quail.' Fl has found a corresponding movement in an intermediate star, 12 m^g.

70 (Σ **2272** : 4·1, 6·1). XVII^h 59^m, N 2° 32′ : 4·5, 7 : 136°·4 : 5″·4, 1830; 119°·7 : 6″·8, 1847 (K 100° : 5″, 1867; 94°·9 : 4″·3, 1871; De 4·4, 6·1 : 77°·5 : 3″·1, 1877) : topaz, purpsh. P Sm thinks 7 var. in col. Fr both yel. 1876. Bin. revolving in about 80 y. (Jacob 88, Encke 74. Schur and Pritchard 94 y., at a distance of 30 times that of Sun, with light-passage, according to Hind, of 20 y.); but with movements so singular that Jacob suspects disturbance from a third invisible companion. H observes that the rings around its telescopic image 'seem to have something peculiar. They are thin, and extend further than in general;' on another occasion he remarks, in measuring it, 'Difficult, owing to the rings and appendages. N.B. I always find this star difficult from the above cause.' [3 minute *comites*, 9 in. spec. 1871.]

τ (Σ **2262** : 5, 5·7). XVII^h 57^m, S 8° 11′; 5, 6 : 214°·5 : 0″·5, 1838 (Hall 248°·9 : 1″·5, 1877) : pale wh. Bin.; Do 218 y. Σ single, 1825. A companion, 10 (Fr 11) : 115° : 82″·7 : light bl., 1838. Bu 9·5 : 126°·9 : 100″·3, 1879.

ρ.[1] XVI^h 18^m, S 23° 10′ : 5, 7·5, 1832 (Jacob 5, 5, 1846; Main 4, 4·3, 1861; H 6, 6) : 3°·1 (Cin. 357°·4, 1879) : 3″·8 : pale topaz, bl. Finely grouped with two 8 m^g. stars, 3° *n* a little *p a* Scorp. H on intensely black ground, in great blank space. (See App. I.)

39. XVII^h 11^m, S 24° 9′ : 5·5, 7·5 : 356°·2 : 12″·1 : pale or., bl. Vertical near meridian; beautiful. Not very distant, XVII^h 23^m, S 21° 16′, was the Great New Star discovered by Möstlin, Kepler's scholar, in 1604; at first sur-

[1] D doubts if rightly lettered. Fr, however, remarks that there is no other ρ in Oph.

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passing Jupiter and even rivalling Venus, but totally vanishing in $1\frac{1}{4}$ y. 39 is easily found, 1° *n p* θ.

73 (Σ **2281** : 5·7, 7·2). XVIII^h 4^m, N 3° 58′ : 6, 7·5 : 260°·5 : 1″·7, 1834 [elong? 1850] (Schi2 50°·6 : 0″·9, 1875) : silvery wh., pale wh. Bin.?

53 (Σ 34 App. I : 5·6, 7·3). XVII^h 29^m, N 9° 40′ : 6, 8 : 192°·5 : 41″·3 : greyish, pale bl.; D 6 light yel., so Fr 1876. 3° *s* of *a*.

19 (Σ **2096** : 6, 9·3). XVI^h 41^m, N 2° 17′ : 6·5, 10 [bright] : 92°·9 : 21″·8 : pale wh., livid. Fine low-power field.

P XVI 270 (Σ **2114** : 6·2, 7·4). XVI^h 56^m, N 8° 37′ : 7, 8 : 137° : 1″·5, 1832 (OΣ 153°·9 : 1″·3, 1875) : wh. (Du wh., pale bl.) Bin.? In a line carried from ϵ through κ as far again.

61 (Σ **2202** : 5·5, 5·8). XVII^h 39^m, N 2° 38′ : 7·5, 7·5 : 93°·9 : 20″·7 : silvery wh., 1833. [*p* considerably the larger, 1850; a little larger, 9 in. spec. 1871, 1876, 1880. Fletcher 6, 7, yel., 1851; Main 7·5, 8, 1861. Closely *p* γ, and 2° nearly *s* from β, a fine specimen of a pale yel. star.]

Σ **2166.** XVII^h 22^m, N 11° 31′ : 5·6, 7·4 : 283°·2 : 27″·5 : wh., blsh.

OΣ **315** (21). XVI^h 45^m, N 1° 25′ : 6·2, 8·1 : 162°·1 : 1″. (Bu bin. In field with Σ **2105** : 8, 9·5 : 130°·4 : 29″·1, 1831.) [8, 9 (Sm's scale), Sept. 11, 1855, $3\frac{7}{10}$ in. achr. Σ's 9·5 would have been extremely minute, and certainly not rated 9 by me.]

Σ **2048** (P XVI 88). XVI^h 22^m, S 7° 52′ : 6·3, 9 : 302°·7 : 4″·7 : yelsh., o. (In Sm, who notes deep or. star in field.)

Σ **2122.** XVII^h 0^m, S 1° 29′ : 6·5, 8·7 : 280°·5 : 20″·1 : wh., o.

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Σ **2106.** XVI^h 45^m, N 9° 36′ : 6·7, 8·4 : 337°·5 : 1″ : wh.

Σ **2244.** XVII^h 51^m, N 0° 7′ : 6·9, 7·1 : 272°·7 : 1″ : wh.

Σ **2191.** XVII^h 33^m, S 4° 54′ : 7, 8 : 268°·2 : 26″·5 : wh.

Bu **125** (P XVI 311). XVII^h 5^m, S 26° 53′ : 7, 11 : est. 90° : 1″·5. (*s p* 36.)

Σ **2283.** XVIII^h 4^m, N 6° 8′ : 7·2, 7·7 : 92°·7 : 1″·2 : 0, 0.

Σ **2159.** XVII^h 19^m, N 13° 27′ : 7·4, 8·1 : 326°·4 : 26″·3 : wh. [Pretty.]

Σ **2186.** XVII^h 30^m, N 1° 5′ : 7·5, 7·5 : 82°·7 : 2″·9 : wh.

Σ **2171.** XVII^h 23^m, S 9° 54′ : 7·5, 7·6 : 75°·7 : 1″·6 : yelsh. wh. (Fl bin.)

Σ **2235.** XVII^h 47^m, S 2° 11′ : 7·5, 9·1 : 123°·5 : 18″·4 : yel., o.

Σ **2222.** XVII^h 42^m, N 14° 54′ : 7·5, 9·2 : 58°·6 : 2″·1 : yel., o.

Σ **2252.** XVII^h 53^m, N 2° 2′ : 8, 8·3 : 22°·9 : 3″·8 : wh.

Σ **2200.** XVII^h 38^m, N 5° 54′ : 8, 8·8 : 168°·2 : 1″·7 : wh.

Σ **2211.** XVII^h 40^m, S 1° 9′ : 8·2, 9·2 : 115°·5 : 9″·7 : wh.

Σ **2254.** XVII^h 54^m, N 12° 29′ : 8·3, 8·7 : 266° : 3″·2 : v. wh.

Σ **2132.** XVII^h 7^m, S 3° 53′ : 8·3, 9 : 108° : 1″·5 : yelsh. wh.

Σ **2156.** XVII^h 18^m, S 0° 42′ : 8·3, 9 : 32°·3 : 3″·3 : yelsh. wh. (Fl bin.?)

Σ **2187.** XVII^h 30^m, N 4° 14′ : 8·3, 9·3 : 177°·6 : 3″·1 : wh.

Σ **2265.** XVII^h 58^m, N 6° 28′ : 8·4, 9·4 : 282°·8 : 24″·5 : wh.

Σ **3107.** XVI^h 53^m, N 4° 7′ : 8·5, 8·5 : 112°·3 : 1″·6 : wh. (Fl bin.?)

[OPHIUCHUS]

Σ **2123.** XVII^h 1^m, N 6° 59′ : 8·5, 8·5 : 218°·4 : 19″·3 : wh.

Σ **2033.** XVI^h 12^m, S 1° 59′ : 8·5, 8·7 : 175°·6 : 10″·7 : v. wh.

Σ **2212.** XVII^h 40^m, N 5° 44′ : 8·5, 8·8 : 341°·5 : 3″·1 : wh.

Σ **2170.** XVII^h 23^m, N 10° 35′ : 8·5, 9 : 76°·3 : 3″·8 : yelsh.

Σ **2188.** XVII^h 30^m, N 6° 42′ : 8·5, 9·2 : 203°·8 : 5″·5 : wh.

Σ **3106.** XVI^h 49^m, S 4° 59′ : 8·6, 8·6 : 246°·6 : 2″·4 : o, o.

Σ **2149.** XVII^h 14^m, S 6° 16′ : 8·8, 8·8 : 23°·2 : 7″·5 : o, o.

[Temporary. XVI^h 53^m, S 12° 42′, about 3° *n p η*. **Hind's New Star, 5 m^g. 1848, April 28,**[1] **which afterwards faded to 11 m^g., but may blaze out again: it was or., with flashes of red, a colour sometimes noticed in other stars. Sa found colour very fine, 1875.**]

Red Stars. B 410. XVII^h 23^m, S 19° 22′ : 8·5.

B 418. XVII^h 38^m, S 18° 36′ : 8·5.

Vars. R. XVII^h 1^m, S 15° 56′ : 7·6, 8·1—below 12 : 302^d.

S. XVI^h 27^m, S 16° 54′ : 8·3, 9—below 12·5 : 233^d. Irregular.

T. XVI^h 27^m, S 15° 52′ : 10—below 12·5. Irregular.

Clusters.

4346 (M 23). XVII^h 50^m, S 19° 0′. Grand low-power field. H about 100 stars 9–10 to 13 m^g. Announced by increasing number.

4238 (M 12). XVI^h 41^m, S 1° 45′. Resolvable; H 10—16 m^g. E. of Rosse slightly spiral; finely grouped.

[1] Airy rated it fully 5 m^g. May 9; 4 m^g. May 10; sinking to 6 m^g. May 18.

[OPHIUCHUS]

4256 (M 10). XVI^h 51^m, S 3° 56′. Bright cl. H II—15 m^g. E. of Rosse tendency to curved branches. A beautiful group lies *f*; *lucida* bright or.

4264 (M 19). XVI^h 55^m, S 26° 6′. A mass of stars: large; fairly bright; but very low. Near the large blank space in the body of Scorpio, where H found scarcely any stars.

4315 (M 14). XVII^h 31^m, S 3° 10′. Large; glimpses of resolution; effected by H with 20 f. refl. (H 15 or 16 m^g., 'the finest star-dust.')

4287 (M 9). XVII^h 13^m, S 18° 24′. Small, apparently resolvable: 'a myriad of minute stars, clustering into a blaze in the centre, and wonderfully aggregated with numerous outliers' (Sm). H 14 m^g.

4211 (H VI 40). XVI^h 26^m, S 12° 47′. Large pale cl. [best with low power.] Comparative desert *f*. See 4264, *supra*, and a list of similar vacancies in App. I.

[About XVII^h 44^m, N 5° 22′, 1½° *n f β*, is a noble broad group, evidently a *family*: among them is Σ **2227**. 8·8, 8·8 : 296°·5 : 19″·6.

[Curious sequence of small stars ± XVIII^h 7^m, N 4° 18′.]

ORION.

The finest constellation in the heavens, equally remarkable for telescopic interest and obvious brilliancy; fortunately, its position is very suitable for English observers, as it comes to the meridian in winter, and attains a sufficient, but not an inconvenient, altitude. Sweeping in many parts most beautiful.

α (Betelgeuze), v^h 49^m, N 7° 23′, is irregularly var. H, the discoverer, found it alternately above *β* (Rigel), and below *α* Tauri: from 1839, Nov. 26 to 1840, Jan. 7, losing

nearly half its light: afterwards its changes were much less conspicuous till 1849. 1852, Dec. 5, Fletcher thought it brighter than Capella, which he rated clearly above Wega, so that it was then the brightest star in the N. hemisphere. He also saw it nearly approaching those stars, 1865, Dec. 25. When brightest, Huggins and Miller find that a group of dark lines fades out of its spectrum, which is remarkable, like that of β Pegasi and others, for the *extreme faintness of the lines of hydrogen*. Huggins thinks it may be receding from us 22 miles per second: Lassell says of it, 'a most beautiful and brilliant gem! Singularly beautiful in colour, a rich topaz; in hue and brilliancy different from any other star I have seen.' Look at α and β alternately to appreciate the contrast.

Double Stars.

β (Σ **668**: 1, 8). v^h 9^m, S 8° 20′: 1, 9, 1832 (K 8·5, 1865–6; Stone 7, 1877): 199°·4: 9″·5: pale yel., sapphire bl. (H 9 pale red; so Kitchener). I see always a blue tinge in the great star, resembling that of Wega; Σ, however, gives yelsh. wh.; Fletcher yel. Sa yelsh. with reflector, blsh. achr., side by side. Huggins supposes it may be receding from us 15 or more miles per second. Beautiful object and fair test for pretty good telescope; but from low altitude often blotted with vapour. B has seen 9 distinctly with 4½ in. achr. just before sunset; and Bu and Fr have detected it with 1½ in. T. T. Smith with 1½ in. silv. spec. Bu and Sa elongated. Mitchel 2^d *comes*; Bu 1°·5: 44″·3.

δ (Σ 14 App. I: 2, 6·8). v^h 26^m, S 0° 23′: 2 (H var; Schönfeld 2·2–2·7), 7: 359°·9: 53″·2: pale wh., flushed wh., 1850 [2 beautiful pale grn., 1850: wh. or pale yel., 1851]. Fr pale yel., fine bl., 1877. This star nearly marks the equator. [Ruddy star 7·5 m^s. n f in large field.] Bu 2 very

minute *comites*: 227°: 33″·8 and 359°: 52″·8; the nearest, *min. vis.* of 15 in. achr.)

ζ (Σ **774**: 2, 5·7). Triple. v^h 35^m, S 2° 0′—very large 3, 6·5, 10: 148°·8, 7°·8: 2″·5, 56″: yel., flushed bl., grey. Fixed, but angles discordant. 6·5, singularly missed by $H_{\odot}$, and discovered by Kunowsky, seems of some nondescript hue, about which observers do not agree. Σ uses a specially manufactured epithet, 'olivacea subrubicunda.'

ι (Σ **752**: 3·2, 7·3). Triple. v^h 30^m, S 5° 59′: 3·5, 8·5, 11, 1832 (Fr 1 m^g. between the latter, 1877): 141°·7, 102°·8: 11″·5, 48″·9: pale wh., blsh., grape red. Field very fine. [A glow with 5½ in. around this group, which E. of Rosse finds to occupy a singular dark opening encompassed by nebulous matter.] Wa very minute pair between 2 brighter stars *n* in field—a test.

λ (Σ **738**: 4, 6). v^h 29^m, N 9° 51′: 4, 6: 43°: 4″·5: pale yel., purpsh. [A very minute *comes*, 5½ in. not in Sm or $H_{\odot}$, but in Σ and Se. Bu 183°·1: 28″·7. Glimpsed by Wa with 2⅞ in. achr. 1875.—Whole region very fine.]

σ (Σ **762**: 4·1, 10·3). Triple. v^h 33^m, S 2° 40′: 4, 8, 7: 84°·2, 60°·8: 12″·5, 41″·8: bright wh., blsh., grape red, 1832, 1850 [4 yel., 1851; 8 ruddy, 9⅓ in. spec. 1869]. An 11 m^g. star *p* 4 escaped some of the first observers; very plain now. Beautiful little triangle *p*, 8·5, 9, 8: dusky, wh., pale grey, with smaller *comes*, and 2 minute stars between the groups. Wa sees all with 2⅞ in. and has pointed out minute pair *n* of 4.

32 (Σ **728**: 5·2, 6·7). v^h 24^m, N 5° 51′: 5, 7: 206°·2: 1″, 1839: bright and pale wh. Closing; K with 7⅓ in. achr. in contact, and generally ill-defined, 1866; Bird barely separated, 10 in. spec. 1872. Du $9\frac{6}{10}$ in. achr. undivided, 1871–1875. Bu est. 0″·8, 1873; measured 197°·5, 0″·52, 1879. It lies *f γ*, a little *s*.

[ORION]

23 (Σ **696** : 5, 7). v^h 17^m, N 3° 26′ : 5, 7 : 27°·9 : 32″·3 : creamy wh., light bl. [beautiful col.] 3° *s* of γ, a little *p*.

ρ^1 (Σ **654** : 4·7, 8·5). v^h 7^m, N 2° 43′ : 5, 8·5, 1835 [8·5 very small 1849, 1856; so Simms 1876. Jacob 10, 1856; so Main 1862]: 61°·8 : 6″·8 : or., smalt bl.

52 (Σ **795** : 6·2, 6·2). v^h 42^m, N 6° 25′ : 6, 6·5 : 199°·9 : 1″·8 : pale wh., yelsh., 1852; Σ tints reversed, 1831, and c. p. m. [In contact, 80, neatly split, 144: excellent test, readily found, about 2° *s p a*. Minute *comes* (Sa 13 m^g.), *n* a little *f*, 9⅓ in. spec.]

33 (Σ **729** : 6, 7·3). v^h 25^m, N 3° 12′ : 6, 8 : 25°·8 : 2″ : wh., pale bl. Between γ and ζ, nearer γ.

P V 84 (Σ **708** : 8·2, 9·8). v^h 19^m, N 1° 49′ : 8, 10 : 322°·5 : 2″·6 : silvery wh., grey. [ψ^1, *p* a little *s*, is in a fine field: about 50′ further *s p* two pairs, P V 67 : or., bl.; and Σ **700**, 8, 8·2 : 5°·3 : 4″·5 : wh. Fr yelsh., blsh., 1877.]

P IV 278, 279 (Σ **630** : 6·8, 8). IV^h 56^m, N 1° 26′ : 8·5, 9, 1833 (Se 5·5, 7; 1856): 49°·3 : 13″·7 : silvery wh., pale bl. [1° *f* π^6, 5 m^g.]

P IV 258 (Σ **622** : 8·2, 8·2). IV^h 52^m, N 1° 29′ : 8·5, 9, 1833 (Σ very nearly equal, 1830, 1833): 180°·4 : 2″·4 : wh., pale grey. This beautiful object may be bin. Closely *s p* π^6.

Σ **747**. v^h 29^m, S 6° 6′ : 5·6, 6·5 : 223°·1 : 36″ : yelsh., ashy. [In group of ι, *s p*. Ward sees *comes* 14 m^g. *f* 5·6.]

Σ **725** (31). v^h 23^m, S 1° 11′ : 5·8, 11 : 87°·5 : 12″·7 : v. gold., o. (Fr 11 bl., 1877, 1879.) [11 easy, 9⅓ in. spec. Sa underrated, clear bl. Buffham 2¼ in. of 9¼ in. refl. A strongly suspects var. 25^s *f*, 3′ 48″ *n*: 9.]

[ORION]

Σ 855. $6^h\ 2^m$, N 2° 31′ : 5·8, 6·8 : 113°·2 : 29″·3 : wh. [A 3d star makes a beautiful group.]

OΣ 98 (14, *alias i*). $5^h\ 1^m$, N 8° 20′ : 6, 6·8 : 217°·9 : 1″·2. Rapid bin. Wa pair *n* a little *f*. Copeland 11·2, 13·4 : 288°·4 : 10″·8.

Σ 750. $5^h\ 30^m$, S 4° 27′ : 6, 8 : 59°·2 : 4″·3 : wh., ash.

Σ 816. $5^h\ 48^m$, N 5° 51′ : 6·2, 8·7 : 289°·3 : 4″·2 : v. wh., o.

Σ 627. $4^h\ 54^m$, N 3° 26′ : 6·3, 7 : 260°·3 : 21″·3 : wh., 1831. (Fr nearly equal, 1877.) [A splendid pair.]

Σ 652. $5^h\ 5^m$, N 0° 53′ : 6·3, 7·8 : 184°·3 : 1″·7 : yelsh., wh.

Σ 754. $5^h\ 31^m$, S 6° 10′ : 6·5, 9·7 : 287°·6 : 5″·2 : wh., bl. (*s f ι*.)

Σ 701. $5^h\ 18^m$, S 8° 33′ : 6·7, 8·5 : 146° : 5″·9 : v. wh., ash. ($8^m\ 48^s$ *f*, 11′ *s*, from *β*.)

Σ 743. $5^h\ 29^m$, S 4° 30′ : 6·9, 8 : 277°·8 : 1″·8 : v. wh. (Fr yelsh., 1877.)

Σ 688. $5^h\ 14^m$, S 10° 52′ : 7, 7·4 : 274°·3 : 10″·5 : yelsh., blsh. wh.

OΣ 125. $5^h\ 52^m$, N 22° 29′ : 7, 8·5 : 357°·2 : 1″·5 : o, red.

Σ 867. $6^h\ 5^m$, N 17° 26′ : 7, 8·5 : 156°·3 : 2″·2 : yelsh. wh., wh.

Σ 734. $5^h\ 27^m$, S 1° 46′ : 7, 8·6 : 356°·4 : 1″·8 : wh., o.—Triple; 8·6 : 243°·1 : 29″·3.

OΣ 123. $5^h\ 48^m$, N 10° 14′ : 7, 8·7 : 175°·9 : 2″·4 : yel., ash.

Σ 712. $5^h\ 20^m$, N 2° 49′ : 7, 9 : 45°·4 : 3″·1 : v. wh., o. (Fl slow bin.)

Σ 721. $5^h\ 23^m$, N 3° 4′ : 7, 9 : 150°·9 : 24″·2 : wh., o. (Fr 9 blsh. or purple, 1877. Bu double, 9·5, 9·5 : 142°·5 : 0″·4.)

[ORION]

Σ **790.** v^h 40^m, S 4° 17′ : 7, 9·3 : 89°·1 : 6″·8 : redsh. yel., bl.

Σ **877.** vi^h 8^m, N 14° 37′ : 7·2, 7·7 : 263°·3 : 5″·3 : yelsh., wh.

Σ **798.** v^h 43^m, S 8° 27′ : 7·2, 9·2 : 181°·4 : 20″·7 : v. wh., o. ($20^s f$, 1° 16′ *n*, from κ.)

Σ **664.** v^h 8^m, N 8° 19′ : 7·5, 8 : 167°·6 : 5″ : wh.

Σ **667.** v^h 9^m, S 7° 14′ : 7·5, 9 : 312°·7 : 4″·2 : v. yel., ash. [Sweeping power, a pale ruby.]

Σ **612.** iv^h 48^m, N 7° 10′ : 7·6, 7·9 : 196°·9 : 16″·6 : wh.

Σ **809.** v^h 45^m, S 1° 27′ : 7·7, 8·8 : 101·2 : 25″·7 : yel., ash. (Fr 8·8 greyish or bl. 1879.)

Σ **853.** vi^h 2^m, N 11° 41′ : 7·8, 8·3 : 340°·1 : 24″·1 : wh. (Moving.)

Bu **326.** vi^h 50^m, N 2° 28′ : De 8, 9·5 : 62°·8 : 1″·2.

Σ **692.** v^h 15^m, S 8° 10′ : 7·8, 8·8 : 4°·2 : 34″·9 : yelsh., wh. (5^m $52^s f$, 12′ *n*, from β.) [Fine wide object.]

Σ **813.** v^h 47^m, N 18° 54′ : 8, 8 : 148°·1 : 3″·2, v. wh.

Σ **589.** iv^h 38^m, N 5° 5′ : 8, 8 : 310°·9 : 4″·5 : yelsh. wh. Bin.? [Beautiful.]

Σ **880.** vi^h 9^m, N 10° 37′ : 8, 8 : 53°·4 : 5″·4 : yelsh.

Σ **757.** v^h 32^m, S 0° 17′ : 8, 8·2 : 239°·8 : 1″·7 : v. wh.—Followed by

Σ **758.** 8·5, 9 : 297°·7 : 11″·1 : v. wh., 1831. (De 9 azure, certain, 1857. Fr blsh. 1877.—Star 8 m^g. *p*. (Pretty group *n* a little *f* ε [pale grn.], which Hɨ saw in large faint neb., but E. of Rosse clear.)

Σ **726.** v^h 24^m, N 10° 10′ : 8, 8·5 : 261° : 1″·2 : wh.

Σ **859.** vi^h 3^m, N 5° 40′ : 8, 8·5 : 249° : 31″·4 : yelsh., wh. (Moving.)

Σ **835.** v^h 57^m, N 18° 19′ : 8, 9 : 146°·6 : 2″·2 : yelsh. wh., ash.

[ORION]

Σ **895** rej. vi^h 14^m, N 5° 48′ : 8–9, 11 : 59°·8 : ± 40″. (H full ruby red, fine green by contrast.) [11 blsh., 1878; so Fr 1879.]

Σ **710.** v^h 20^m, S 11° 26′ : 8·2, 8·3 : 193°·6 : 10″·7 : wh.

Σ **817.** v^h 48^m, N 7° 0′ : 8·2, 8·3 : 72°·4 : 18″·5 : wb., certain yel. (*s* of *a*.)

Σ **792.** v^h 41^m, S 3° 17′ : 8·2, 8·7 : 133°·9 : 24″·9 : yelsh. [Very pretty.]

Σ **763.** v^h 33^m, N 10° 14′ : 8·2, 8·8 : 320°·1 : 5″·8 : yelsh., yelsh. wh.

Σ **826.** v^h 53^m, S 1° 19′ : 8·2, 9·2 : 115°·5 : 1″·8 : wh. (Fl bin.)

Σ **678.** v^h 11^m, N 4° 33′ : 8·3, 8·8 : 96°·5 : 3″·3 : wh.

Σ **820.** v^h 49^m, N 8° 58′ : 8·3, 8·8 : 110°·3 : 4″·7 : o, o.

Σ **620.** iv^h 52^m, N 13° 46′ : 8·4, 9·4 : 226°·3 : 3″·6 : yelsh. wh., o. (Fl bin.?)

Σ **643.** v^h 1^m, N 8° 15′ : 8·5, 8·5 : 295°·2 : 2″·7 : o, o.

Σ **840.** vi^h 0^m, N 10° 47′ : 8·5, 8·7 : 183°·5 : 0″·9 : o, o. —Triple; 6·2 : 247°·2 : 21″·1 : yelsh. wh. (Close pair Fl bin.)

Σ **609.** iv^h 46^m, N 1° 2′ : 8·5, 8·7 : 82°·1 : 1″·9 : yel.

Σ **614.** iv^h 49^m, S 0° 43′ : 8·5, 8·9 : 68°·4 : 4″·1 : wh.

Σ **731.** v^h 25^m, S 2° 11′ : 8·5, 9 : 331°·6 : 4″·6 : wh. [9·5^m *p* ζ, 9′ *s*. Beautiful pair.]

Σ **735.** v^h 27^m, S 6° 35′ : 8·5, 9 : 355°·2 : 30″·9 : o, o.

Σ **823.** v^h 52^m, S 7° 39′ : 8·5, 9·2 : 339°·3 : 7″·5 : wh.

Σ **693.** v^h 15^m, S 2° 8′ : 8·7, 9 : 8°·9 : 3″·6 : wh. (2^m 50^s *p*, 23′ *n*, from η.)

[η. v^h 18^m, S 2° 31′ : 4, 5 : 87° : 1″ : wh., purpsh., D 1848; K 89°·8 : 1″, 1866; Bu 79° : 0″·9, 1879. Excellent test, but low; discovered by D. 5½ in. with 212 sometimes split it. Buffham divides it with 4½ in. of 9 in. spec.] Fixed. B 4 *comites*. Bu faint pair *s f*, 10, 10¼ m^{gs}.

[ORION]

(Bu 188. τ. Quadruple. v^h 12^m, S 6° 58′ : 4, 14, 12, 16 : Hall 250°·1, 59°·8, 36″, 36″; 14 and 16″, 49°·3, 3″·8. Fine test. Fr well seen 11¼ in. spec. Sm triple. Next large star *n f* β.)

[ψ². v^h 21^m, N 2° 59′ : 5·5, 11 : 322°·3 : 2″·8 : yel., fine bl. Discovered by K, 1863; well seen, Bu 3½ in. of 6 in. achr.; strangely missed by H, Σ, OΣ. In a grand region. A little *s p* is Σ **712**, *supra*.]

[H 702. v^h 23^m, S 2° 3′ : (12^m *p* ζ, 3′ *s*.) 8,9 : 230° : 20″. Es 2 more pairs in field, est. 8, 10 : 350° : 10″; with *comes p*; and 8, 12 : 38° : 3″–4″. Beautiful combination.]

[Quadruple in line. ± v^h $20·5^m$, N 3° 3′.]

(Three pairs in field. ± 1° *p* π^2. IV^h 44^m, N 8° 42′.—7, 13; 8, 11; 9, 12. B.)

[Curious triplet. ± v^h $30·5^m$, N 0° 13′ ($4·5^m$ *f* δ) : est. 9·75, 10, 10·25.]

[Red Star. B 96. IV^h 59^m, N 1° 1′ : 6.]

Vars. R. IV^h 52^m, N 7° 57′ : 8·7, 8·9—below 13 : 379^d : decrease slower than increase, unsteady: red. Hind.

S. v^h 23^m, S 4° 50′ : 9?—below 13·5? : 410^d? v. red. Webb.

Es has given a list of suspected vars. in *Eng. Mech.*, Jan. 17, 1879.

Clusters and Nebulæ.

1184 (H 362). v^h 30^m, S 4° 27′. Brilliant field, containing Σ **750** and Σ **743**, *supra*. A grand neighbourhood: sweep well over the whole space from 42 to ι, which star large apertures involve in haze, connected by a long faint loop with the Great Nebula.

[ORION]

1361 (HH VIII 24). $6^h\ 2^m$, N 13° 59′. Triangular cl., containing pair, Σ **848** : 7·5, 8·5 : 2″·4 : lucid wh. 1° *s* of *ν*. 'These gatherings, occurring indifferently upon the *Via Lactea* and off it, awaken still more our admiration of the stupendous richness of the Universe, in every department of which there appears such a profusion of creation, if we may so express ourselves of the works of the ALMIGHTY, in which our utmost ken has yet never detected any redundancy, much less anything made in vain.' (Sm.)

1179 (M 42). $5^h\ 29^m$, S 5° 28′. The GREAT NEBULA IN ORION, one of the most wonderful objects in the heavens; readily visible to the naked eye.[1] The telescope shows an irregular branching mass of greenish haze, in some directions moderately well defined where the dark sky penetrates it in deep openings; in others melting imperceptibly away over such an extent that Se, by moving his telescope rapidly to gain full contrast, has traced it in singular convolutions, and with a considerable break near *σ*, through 5½° of Dec. and 4° of RA,—from *ζ* to 49, and probably to HH V 38—a prodigious diffusion. Bond II also found it encompassed by a distant nebulous loop; and in various parts detected about 20 curved wreaths, indicating somewhat of a spiral structure. Its real nature was long a profound mystery. It resisted HH's 40 f. refl., in which it was one of the first objects viewed, and, together with that in Andromeda, suggested to him the widely-discussed Nebular Hypothesis, which would see here an unformed fiery mist, the chaotic material of future suns. H found but the aspect of 'a curdling liquid, or a surface strewed over with flocks of wool, or the breaking up of a

[1] It was strangely missed, as Humboldt says, by Galileo, who paid great attention to Orion. Cysatus compared it telescopically with the comet of 1618.

mackerel sky.' The E. of Rosse, with his 3 f. refl., La, with his 2 f. spec. in the Maltese sky, could advance no further: it was long believed that the 6 f. mirror of the E. of Rosse had lifted the veil, and distinguished in some places its starry composition; Bond, too, arrived at the same conclusion; and Se with smaller, but very perfect means, thought he could detect the glittering 'star-dust.' Yet, though this would imply a permanent form, there were strange discrepancies in the drawings by the best hands. H in England, the same observer at the Cape of Good Hope, Bond, La, Liapounov with a $9\frac{1}{2}$ in. achr. at Kazan, OΣ at Poulkova, all differed in various ways; the latter even believed that the brightness of the central part was in a state of continual variation: and the subsequently published labours of Rosse, La, and Se are far from correspondent in detail. All this is strange; and the spectrum-analysis of Huggins has only added to the wonder, by exhibiting it as a mass of incandescent gases, nitrogen, hydrogen, and others unknown![1] In the densest part, four stars, 6, 7, 7·5, 8 m^g.,[2] form a trapezium. Sm gives their colours pale wh., faint lilac, garnet, reddish. Bu and Gore have seen them with $1\frac{1}{2}$ in. Σ in 1826 discovered a fifth star, which is believed to have become visible only of late years; perhaps it may be brightening, as it has been seen with $3\frac{8}{10}$ in., and, it has been said,

[1] Here only, and in 4964 (H IV 18) Androm. he finds a 4th gas-line. Several nebulæ show but one.—Rerum natura sacra sua non simul tradit. Initiatos nos credimus; in vestibulo ejus hæremus. Illa arcana non promiscue nec omnibus patent, reducta et in interiore sacrario clausa sunt: ex quibus aliud hæc ætas, aliud quæ post nos subibit, dispiciet. Tarde magna proveniunt.—SENECA, *quoted by Humboldt.*

[2] D remarks that they should be numbered θ^1, θ^2, &c., in order of RA, not of brightness.

[ORION]

even with $2\frac{1}{8}$ in. Bond's achr. ($14\frac{3}{4}$ in.) has shown it in full daylight. E. of Rosse sees it very red. H added a 6th still smaller, near the brightest star, 1830, Feb. 13, with South's $11\frac{3}{4}$ in. achr. Both have been thought var. Bu has seen both with 3 in.; T. T. Smith with 3 in. of silvered mirror. Two or three other most minute points have occasionally been detected, which, however, the Chicago and Washington achrs. fail to show. OΣ thinks that several involved stars are subject to change, and remarks that 'the existence of so many variable stars on such a small space in the central part of the most curious nebula in the heavens must of course induce us to suppose these phænomena intimately connected with the mysterious nature of that body.' A considerable aperture will show how beautifully one large star, nearly opposite the great dark opening, is encompassed by a spiral mass of haze. Clear weather must of course be chosen, and the lowest power which will bring out the trapezium is most likely to give a satisfactory contrast with the exterior darkness. As regards the nebula, *sketching*, in the ordinary sense, would be to little purpose; but careful *drawing*, with a large aperture and including all visible stars, might prove valuable.

1267 (M 78). v^h 41^m, S 0° 2′. Singular 'wispy' neb., easily found by sweeping 14^m *f* δ, 20′ *n*. Best defined *n*, (E. of Rosse spiral? d'A 6′ or 7′), enclosing pair 8·5, 9 : 32° : 45″ (Bu 50″·8, 1878), 1836 [stars much smaller, 1850, 1856, 1864; d'A 9, 10, 1855; 10, 10, 1864; Fr 11, 12, 1879]. Bu *n* star double, 9, 11·5 : 85°·3 : 1″, 1874. H 3^d star; d'A var. 12–14? 4^m *p*, 3′ *s*, is Σ **782**.

1225 (HH IV 34). v^h 35^m, N 9° 2′. Small, distinct, faint, blsh., plan. Gas. [Not found.]

[1227 (HH V 28). Faint but extensive neb. immediately *f* ζ: d'A 4 large patches. 2 with $9\frac{1}{3}$ in. spec.]

PEGASUS.

A constellation easily recognised by the great square[1] which three of its principal stars form with that in the head of Andromeda.

Double Stars.

ε. Triple. $21^h\ 38^m$, N 9° 20′ : 2·5, 14, 9 : 327°, 324°·3 : 85″, 138″·1 : bright yel., bl., viol. This object, when near the meridian, well exhibits a phænomenon noticed by H,—the pendulum-like oscillation of a small star in the same vertical with a large one, when the telescope is swung from side to side; this he thinks is due to the longer time required for a fainter light to affect the retina, so that the reversal of motion is first perceived in the brighter object. I have seen this strikingly in δ and ζ Orion. and δ Herc.

1 (Σ 11 App. II. : 4·5, 8·6). $21^h\ 17^m$, N 19° 17′ : 4, 9 : 310°·8 : 36″·4 : deep yel., lilac bl. 4 var? C. p. m? P Sm *comes*, 14·5 : 22°·6 : 80″·7.

κ (Σ **2824** : 3·9, 10·8). $21^h\ 39^m$, N 25° 6′ : 4, 13, 1836 [more like 11, 1852; 13, 1871, 9 in. spec. De var.] : 310° : 12″ (Gl 302°·5 : 12″·1, 1874) : pale wh. [yelsh., 1871], purp. Good light-test. 4 one of Bu's closest pairs—perhaps 0″·2.

π^1. $21^h\ 4^m$, N 32° 35′ : 5 : yel., forms a grand pair with π^2, 4 m^g. [yel.]. Sm 2 distant *comites*; Bu a 3^d more minute.

57 (Σ **2982** : 5·9, 10·5). $21^h\ 4^m$, N 8° 2′ : 5·5, 13 : 197° : 35″ : or., grnsh. [not examined].

3 (Σ 56 App. I : 6, 7·4). $21^h\ 32^m$, N 6° 5′ : 6, 8, 1837 (De 6, 7, 1865) : 349°·5 : 39″·3 : flushed wh., greyish : P Sm thinks col. of 8 var. Sa 1 m^g. diff. 1874. Another very pretty pair in field; 0Σ **443**, 8, 8·3; De 8·8, 9·2 : 349°·5 : 7″·9 : wh.

[1] Within this area A's *Uranometria Nova* contains barely 30 naked-eye stars. Schm in the sky of Athens counted 102.

[PEGASUS]

33. XXII^h 18^m, N 20° 15′ : 6·5, 8 : 340°·8 : 57″·9 : yelsh., pale grey. 6·5 has a 10 m^g. attendant at 178°·9 : 2″·7 (Σ **2900** : 6, 9·2) [not seen, 1850; nor by Wilson and Seabroke, 1876, though measured 1″·8, 1874]. Bin.? This object is the leader of a line of 6 similar stars.

P XXII 306 (Σ **2978** : 6·8, 8). XXIII^h 2^m, N 32° 11′ : 7, 8·5 : 146°·4 : 8″·5 : bright wh., sapph. bl., 1833; Slack aquamarine, tawny, 1865. [Several little pairs similar to each other lie dispersed in this region.]

P XXII 33 (Σ **2877** : 6·4, 9·6). XXII^h 9^m, N 16° 36′ : 7·5, 10·5 : 315°·4 : 6″·5 : lucid yel., sea-grn., col. very marked, 1833; Bu 351°·9 : 10″·5, 1878. C. p. m.

P XXIII 216, 217 (Σ **3044** : 6·9, 7·3). XXIII^h 47^m, N 11° 15′ : 8·5, 8·5 : 102° : 18″·5 : silvery wh., 1834; so Σ 1830, yet I saw them wh., pale bl., 1850–1, not quite alike, 1856; De bleu cendré, cendré azure, decided, 1858. The m^{gs}. I also found obviously unequal, *p* the smaller; though not then aware that Σ had found the diff. vary a whole m^g., or that other estimates were discordant. The period of this change should be investigated.

Bu **733** (85). XXIII^h 56^m, N 26° 27′ : 6, 9 : 33°·6 : 14″·4, 1877. *Comes* 12·5 m^g. (Σ's scale) close to 6, rapid bin. 6 has perceptible parallax and large prop. mot. (Most interesting system.)

OΣ **483** (52). XXII^h 53^m, N 11° 5′ : 6·2, 7·7 : 196°·1 : 1″·2 : wh., red. (Moving.)

Σ **2878**. XXII^h 9^m, N 7° 23′ : 6·5, 8 : 130°·8 : 1″·4 : wh. (Ferrari 7, 8 : yel., bl., 'belles couleurs.' Moving? Wa faint star *n p*.)

Σ **2841**. XXI^h 49^m, N 19° 9′ : 6·5, 8 : 111° : 22″·2 : v. yel., bl.

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Σ **2799.** XXI^h 23^m, N 10° 34′ : 6·6, 6·6 : 332°·9 : 1″·4 : yelsh. (Fl slow bin.) [Beautiful.]

Σ **2797.** XXI^h 21^m, N 13° 10′ : 6·7, 8·2 : 213°·3 : 3″·2 : v. wh., ash. (Fl bin. ?)

Σ **2908.** XXII^h 22^m, N 16° 39′ : 7, 8·7 : 116°·3 : 8″·9 : yelsh. wh., o.

Σ **2857.** XXII^h 0^m, N 9° 29′ : 7, 8·7 : 113°·8 : 19″·5 : wh., ash.

Σ **2920.** XXII^h 28^m, N 3° 36′ : 7·1, 8·2 : 144° : 13″·6 : wh.

Σ **2848.** XXI^h 52^m, N 5° 22′ : 7·2, 7·5 : 54°·9 : 10″·4 : wh., yelsh. or red, 1829. (D v. wh. 1841. Fr as Σ, 1876. Heis naked eye.)

OΣ **503.** XXIII^h 36^m, N 19° 38′ : 7·2, 7·8 : 132°·6 : 1″·8 : blsh. wh.

Σ **2804.** XXI^h 27^m, N 20° 11′ : 7·3, 8 : 316°·9 : 2″·9 : wh. 1831. (Do 326°·9 : 3″, 1876. Slow bin.) [Very beautiful pair.]

OΣ **494.** XXIII^h 15^m, N 21° 18′ : 7·4, 8·1 : 83°·6 : 3″·3. blsh. wh.

Σ **2854.** XXI^h 58^m, N 13° 4′ : 7·7, 8 : 83°·1 : 3″·1 : wh.

Σ **2881.** XXII^h 9^m, N 28° 57′ : 7·7, 8·2 : 111°·4 : 1″·8 : yelsh., blsh. wh. (Fl slow bin.)

Σ **2861.** XXII^h 0^m, N 20° 15′ : 7·7, 8·2 : 219°·9 : 7″·1 : wh.

OΣ **452.** XXI^h 50^m, N 6° 41′ : 7·7, 8·8 : 179°·1 : 1″·2.

Σ **3021.** XXIII^h 25^m, N 15° 34′ : 7·7, 8·9 : 308°·9 : 8″·3 : wh., ashy.

Σ **2767.** XXI^h 5^m, N 19° 29′ : 7·8, 8·2 : 30°·6 : 2″·5 : v. wh.

Σ **3013.** XXIII^h 21^m, N 16° 0′ : 7·8, 9·3 : 270° : 2″·6 : wh., o.—In field with

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Σ 3012. . . . . . 8·7, 8·8 : 190°·8 : 2″·6 : wh.

OΣ 497. XXIII^h 25^m, N 8° 49′ : 7·9, 8·6 : 213°·1 : 1″·3.

Σ 2867. XXII^h 4^m, N 7° 19′ : 7·9, 9 : 208°·1 : 10″·5 : yelsh., blsh.

Σ 2974. XXII^h 59^m, N 32° 44′ : 8, 8 : 159°·7 : 2″·8 : v. wh.

Σ 3061. o^h o^m, N 17° 12′ : 8, 8 : 148°·4 : 7″·6 : wh. (In field with **Σ 3060**, *infra.*)

OΣ 445. XXI^h 34^m, N 20° 11′ : 8, 8·5 : 113°·1 : o″·8.

Σ 20. o^h 11^m, N 15° 50′ : 8, 9 : 230°·1 : 12″·2 : o, o.

Σ 2828. XXI^h 43^m, N 2° 50′ : 8, 9 : 142°·5 : 23″·8 : wh.—Triple; 9·2 : 37° : 3″·6 : wh. (Bin. ?)

Σ 3041. XXIII^h 42^m, N 16° 25′ : 8·1, 8·2 : 183°·4 : 3″·3 : wh.—Triple; 7·3 : 347°·6 : 71″·1 : wh. (Bin.?)

Σ 2829. XXI^h 44^m, N 30° 9′ : 8·2, 8·9 : 15°·6 : 17″·1 : wh.

Σ 2934. XXII^h 36^m, N 20° 48′ : 8·2, 9·2 : 187°·8 : 1″·2 : yelsh. wh., wh., 1830. (Gl 163°·6 : 1″·2, 1873. Bin.)

Σ 2868. XXII^h 4^m, N 21° 57′ : 8·3, 8·8 : 5°·1 : 1″·1 : wh.

Σ 2910. XXII^h 23^m, N 22° 55′ : 8·3, 8·8 : 347°·2 : 5″·3 : wh. (Bin. ?)

Σ 67. o^h 46^m, N 9° 57′ : 8·3, 9 : 13° : 1″·6 : wh. (Fl bin.)

Σ 2990. XXIII^h 7^m, N 21° 27′ : 8·5, 8·5 : 69°·1 : 1″·6 : wh.

Σ 2905. XXII^h 21^m, N 14° 33′ : 8·5, 8·5 : 283°·8 : 3″·3 : wh.

Σ 2945. XXII^h 44^m, N 30° 41′ : 8·5, 8·5 : 292°·6 : 3″·9 : wh.

Σ 3060. o^h o^m, N 17° 25′ : 8·5, 8·7 : 110°·5 : 3″·9 : yelsh. (Fl bin.?) (In field with **Σ 3061**, *supra.*)

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Σ **2915.** XXII^h 26^m, N 6° 48′ : 8·5, 8·7 : 169° : 12″·3 : wh., 1827. (De 158°·8 : 12″·2, 1863.)

Σ **3006.** XXIII^h 16^m, N 34° 47′ : 8·5, 9 : 182°·8 : 4″·6 : wh. (Slow bin.)

Σ **2997.** XXIII^h 11^m, N 20° 44′ : 8·5, 9 : 223°·1 : 24″·4 : wh.

Σ **2901.** XXII^h 18^m, N 3° 13′ : 8·5, 9·1 : 147°·1 : 2″·8 : wh.

Σ **3000.** XXIII^h 13^m, N 24° 33′ : 8·7, 8·8 : 52°·3 : 3″·2 : wh.

Σ **2954.** XXII^h 49^m, N 14° 35′ : 9, 9 : 28°·6 : 36″·7 : 0, 0.

Σ **3134.** XXII^h 35^m, N 29° 24′ : 9, 9·3 : 76°·2 : 6″·1 : 0, 0.

[η. XXII^h 37^m, N 29° 36′ : 3 m^g. has, like ϵ, a blsh. 10 m^g. companion, but the large star is paler yel. Schm thinks its tint var. more or less red in different years.]

[Pair ± XXIII^h 8^m, N 10° 30′ : 6, 10 : yel., bl.] (Σ **2991** rej.)

[Pair ± XXII^h 50^m, N 27° 20′ : est. 7·5, 10 : 130° : 19″ : wh., bl.] (Σ **2952** rej.)

[Pair ± XXIII^h 7^m, N 11° 53′ : 9, 9. Insulated.] (H 3176.)

Vars. β. XXII^h 58^m, N 27° 26′ : 2·2—2·7. Irregular.]

R. XXII^h 1^m, N 9° 54′ : 6·9, 7·7—12 ? 382^d (not certain).

S. XXIII^h 14^m, N 8° 16′ : 7·6—below 12·2 : 316^d ?

T. XXII^h 3^m, N 11° 57′ : 8·8, 9·3—below 12·5 : 367^d.

Nebula and Group.

4670 (M 15). XXI^h 24^m, N 11° 38′. Bright and resolvable (H 15 m^g.), blazing in centre; a glorious object with 9½ in. 'With' mirror. Very fine specimen of a completely insulated cl., discovered by Maraldi, 1745. Buffham

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with 9 in. spec. finds a dark patch near the middle, with 2 faint dark 'lanes' or rifts, like those in M 13, unnoticed by H or d'A.

[Bright Group. ± xxi^h 51^m, N 7° 4′.]

PERSEUS.

Here again we enter upon one of the most splendid portions of the Galaxy. Night after night the telescope might be employed in sweeping over its magnificent crowds of stars, among which many beautiful pairs, with the aspect of connection, would be found. This constellation includes the most conspicuous of, at least, the regularly variable stars, β, or Algol (III^h 0^m, N 40° 30′), which changes from 2 to 4 m^g. in a few seconds less than 2^d 20^h 49^m, the increase and decrease together occupying not more than 7^h, the minimum only 18^m: so that it usually appears 2 m^g. There are, however, slight irregularities in these times,—probably the slow working of some unknown general law, which may affect all these wonderful bodies.—Schr discovered, 1787, a *comes*, sometimes invisible; Sa ± 192° : 82″ : var. 10 to below 14 m^g. in some short period.

Double Stars.

ε (Σ **471** : 3·1, 8·3). III^h 50^m, N 39° 40′ : 3·5, 9, 1832 : 9°·1 : 8″·4 : pale wh., lilac. [9 very small, 1849, several times, once with Bishop's 7 in. achr.; so my 5½ in. 1863, and Sa 1874. Yet De 8 of Σ's scale, 1855, Fr not small, 1877.]

ζ (Σ **464** : 2·7, 9·3). Quadruple. III^h 47^m, N 31° 32′ : 3·5, 10, 12, 11, 1832 : 206°·6, 198°·1, 185° : 13″·2, 82″·9, 121″ : flushed wh., smalt bl., ashy, bl. The attendants

seemed to me, 1850, to increase their size with their distance; 10 however might have been overpowered by 3·5. So Hunt, 1861. ♅ also appears to have found but 3; can one be var.? H, D, Bird, and K see a minuter 5th star, quite obvious with $9\frac{1}{3}$ in. spec. K gives 290°·2 : 34″, 1860 : also 90″ for 12. Wa and Sa several others within 2′.

η (Σ **307** : 4, 8·5). $11^h\ 42^m$, N 55° 24′ : 5, 8·5 : 300°·4 : 28″·4 : redsh. yel., bl. [8·5 more like 10, 1876.] Barlow, Bu and Wa 5 faint companions; Wa and Bu one double, 2″·5.

P II 220, 222 (Σ **331** : 5·3, 6·7). $11^h\ 52^m$, N 51° 53′ : 6, 8 : 85°·5 : 12″·5 : silvery wh., sapph. bl. Visible to naked eye, forming triangle with γ and τ.

20 (Σ **318** : 5·5, 10). $11^h\ 46^m$, N 37° 51′ : 6·5, 10 : 236°·5 : 13″·9 : pale wh., sky bl. 'Neat test object (Sm), which $3\frac{7}{10}$ in. showed readily, and Gore saw with 3 in. achr. Bu 6·5 extremely close pair, 0″·25. Next f 16, 5 m^g.

12. $11^h\ 35^m$, N 39° 41′ : 6 : yel., has 2 pairs near it in large field; one Σ **292** : 7·5, 8·2; 210°·7 : 23″·1 : wh.

58. $1v^h\ 28^m$, N 41° 1′ : 5·5 : or., has Σ **563** in field; Sm 7·5, 9 : 29°·8 : 11″·8 : grnsh., lilac. Another pair, 10, 11, *sp.*

57. $1v^h\ 25^m$, N 42° 48′ : 8, 8 (De 5·5, 6·5) : 199°·8 : 110″·3 : wh., 1833 [not exactly alike in col., 1852]. Fr 0·5 m^g. diff. : yelsh., blsh., 1877.

♅ VIII 80 (Σ **446** : 7, 9·2). $111^h\ 40^m$, N 52° 18′ : 8, 11 : 255° : 9″·5 : light yel., pale viol. In cl. so named, G. C. 775.

Σ **431** (o). $111^h\ 35^m$, N 33° 35′ : 4·2, 9·5 : 237°·2 : 20″ : grnsh. wh., o. (40 in Bedford catalogue.)

Σ **533**. $1v^h\ 17^m$, N 33° 59′ : 6, 7·5 : 60°·3 : 19″·6 : wh. 1831. (De pale red, pale bl., certain, 1857. Fr 7·5 *blsh.*, 1877.) [In a grand field with 55, 6 m^g.]

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OΣ **81** (56). IV^h 17^m, N 33° 41′ : 6, 8·8 : 53° : 4″·5 : yel., o.

Σ **552.** IV^h 23^m, N 39° 44′ : 6·3, 6·5 : 114°·4 : 9″ : v. wh.

Σ **369.** III^h 9^m, N 40° 2′ : 6·5, 7·8 : 28°·8 : 3″·3 : yelsh. wh., blsh. wh.

Σ **336.** II^h 54^m, N 31° 57′ : 6·5, 8 : 8°·6 : 8″·2 : yel., bl. (Opening.)

OΣ **531** (P III 242). IV^h 0^m, N 37° 46′ : 6·5, 8·2 : 147°·9 : 3″·3 : yel., red, 1855. (De 139°·3 : 2″·8 : 1875.)

Σ **314.** II^h 44^m, N 52° 30′ : 6·9, 7·1 : 295°·4 : 1″·5 : wh. (Fl slow bin.)

Σ **268.** II^h 21^m, N 55° 0′ : 6·9, 8·2 : 129°·1 : 2″·7 : wh., bl.

Σ **434.** III^h 36^m, N 38° 0′ : 7, 7·8 : 88°·2 : 28″·3 : gold, blsh. (Widening : optical.)

Σ **426.** III^h 33^m, N 38° 44′ : 7, 8·5 : 340°·6 : 19″·7 : wh.

Σ **249.** II^h 14^m, N 44° 3′ : 7, 9 : 194°·7 : 2″·3 : v. wh., ash. (Fl slow bin.?)

Σ **565.** IV^h 30^m, N 41° 52′ : 7·2, 8·5 : 180°·3 : 1″·6 : yelsh., blsh.

Σ **425.** III^h 33^m, N 33° 44′ : 7·3, 7·3 : 104°·6 : 2″·9 : v. wh. [A true 'pair,' a little *p* 40, 6 m^g.]

Σ **391.** III^h 21^m, N 44° 39′ : 7·3, 8 : 94°·8 : 3″·8 : wh., purpsh.

Σ **301.** II^h 39^m, N 53° 25′ : 7·3, 8·3 : 16°·6 : 8″·2 : yelsh., blsh,

OΣ **59.** III^h 32^m, N 45° 38′ : 7·5, 7·8 : 349°·5 : 2″·4 : redsh.

Σ **476.** III^h 53^m, N 38° 18′ : 7·5, 8·7 : 283°·8 : 17″·6 : yel., bl. (midway between η and 49).

Σ **360.** III^h 5^m, N 36° 46′ : 7·8, 8 : 146°·4 : 1″·3 : yelsh. (Fl slow bin.)

[PERSEUS]

OΣ **44.** $11^h\ 35^m$, N 42° 10′ : 7·8, 8·5 : 58°·6 : 1″·5 : blsh.

Σ **447.** $111^h\ 40^m$, N 37° 59′ : 7·8, 9 : 178°·3 : 26″·5 : yelsh., o. (Moving.)

OΣ **51.** $111^h\ 5^m$, N 43° 50′ : 7·9, 8·1 : 300° : 1″·4.

Σ **297.** $11^h\ 37^m$, N 56° 2′ : 8, 8·3 : 276°·6 : 15″·6 : wh.

Σ **439.** $111^h\ 37^m$, N 31° 48′ : 8, 9·2 : 38°·1 : 23″·2 : yelsh., o.

Σ **272.** $11^h\ 25^m$, N 57° 54′ : 8·2, 8·2 : 42°·3 : 1″·7 : v. wh.

Σ **260.** $11^h\ 18^m$, N 53° 44′ : 8·2, 8·7 : 348°·1 : 6″·6 : wh.

Σ **443.** $111^h\ 39^m$, N 41° 7′ : 8·2, 8·8 : 44°·3 : 9″·1 : wh. [2d star nearly *s* of *r*, ± 1°.]

Σ **388.** $111^h\ 20^m$, N 50° 2′ : 8·2, 9·2 : 210° : 2″·9 : wh.

Σ **512.** $1v^h\ 7^m$, N 45° 7′ : 8·3, 8·3 : 225°·9 : 5″·2 : wh.

Σ **477.** $111^h\ 54^m$, N 41° 31′ : 8·3, 9·3 : 213°·4 : 3″ : wh., o.

Σ **413.** $111^h\ 28^m$, N 33° 17′ : 8·5, 8·5 : 130°·3 : 2″·5 : wh.

Σ **364.** $111^h\ 6^m$, N 38° 42′ : 8·5, 8·5 : 310°·5 : 11″·4 : wh.

Σ **316.** $11^h\ 45^m$, N 36° 48′ : 8·5, 8·7 : 134°·3 : 13″·9 : wh.

Σ **235.** $11^h\ 9^m$, N 55° 20′ : 8·5, 9 : 43°·4 : 1″·7 : yelsh. wh.

Σ **213.** $11^h\ 1^m$, N 50° 29′ : 8·5, 9 : 320° : 1″·9 : o, o.

Σ **500.** $1v^h\ 3^m$, N 39° 58′ : 8·5, 9·5 : 79° : 3″·9 : yelsh. wh.

[P III 28. $111^h\ 13^m$, N 48° 39′, near *a*, *s* a little *p* : 6 : or. has fine bl. companion in beautiful field.]

Red Stars. [B 41. $11^h\ 14^m$, N 56° 35′ : 8·6. In the sword-hand : see 512, 521, *infra*.]

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[B 61. III^h 21^m, N 54° 58′ : 7·5. Webb.]

Vars. ρ. II^h 57^m, N 38° 23′ : 3·4—4·2. Irregular.
R. III^h 22^m, N 35° 15′ : 8·1, 9·2—12·5 : 208^d.
S. II^h 15^m, N 58° 2′ : 8·5?—below 9·7.

Nebulæ and Clusters.

385, 386 (M 76 and ℍ I 193). I^h 35^m, N 50° 59′. Pearly-wh. neb. double [curious miniature of M 27, and like it, *gaseous*; *p* a little the brighter]. E. of Rosse spiral.

512, 521 (ℍ VI 33, 34). II^h 11^m, N 56° 36′. These two gorgeous clusters, described by Sm as 'affording together one of the most brilliant telescopic objects in the heavens,' are visible to the naked eye as a protuberant part of the Galaxy, and so ℍ considered them. They are often called *the sword-hand of Perseus*. With 64 these superb masses were visible together, as well as a bright pair *n*. 5½ in. showed a red star between them. Sm mentions a ruby and a garnet in 521. 9½ in. spec. shows 5 red stars in all. T. T. Smith sees 8.

584 (M 34). II^h 35^m, N 42° 17′. Just perceptible to naked eye; very grand low-power field, one of the finest objects of its class. It contains a little 8 m^g. pair, 14″ apart.

553 (H 227). II^h 25^m, N 57° 0′. Wide cl. H 13–15 m^g. A little *f* 512.

658 (ℍ VI 25). III^h 7^m, N 46° 47′. A low power shows a very faint large cloud of minute stars (H 12–15 m^g.), beautifully bordered by a brighter foreshortened pentagon.

[820 (ℍ VII 61). IV^h 6^m, N 50° 54′. Bright cl. good low-power object; larger stars in curves.]

[Beautiful field, about II^h 13^m, N 54°.]

PISCES.

A dull region, containing some good telescopic objects.

[PISCES]

Double Stars.

α (Σ **202** : 2·8, 3·9). 1h 56m, N 2° 11′ : 5, 6 : 334°·7 : 3″·6, 1834 (K 325°·8 : 3″·2, 1865) : pale grn., bl., 1834, 1838, 1850; Σ ditto 1831; D very wh., wh., 1846; Fletcher both yel., 1851; De wh., ashy wh., 1854; P Sm both wh., 1856; so Du 1868, 1871, 1872. I found the contrast certain, but 6 troublesome as to colour, usually ruddy or tawny, sometimes blsh. (see p. 245). 1855, $3\frac{7}{10}$ in. I noted it pale yel., brown yel., 'quite satisfactory;' 1860, $5\frac{1}{2}$ in. pale yel., tawny or fawn-coloured, 'certain;' 1862, 6 blsh.?? no strong contrast; 1871, 9 in. spec. brownish; at first fancied blsh. Both mgs. very variously given; but Fl remarks with always about 1 mg. diff. Fletcher, Jacob, and D think this fine object may be bin.

ψ^1 (Σ **88** : 4·9, 5). 0h 59m, N 20° 50′ : 5·5, 5·5 : 160°·4 : 30″·2 : flushed wh., pale wh. H star 11 mg. *f*; Fr 2 in. 1877.

65 (Σ **61** : 6, 6, 1832). 0h 43m, N 27° 4′ : 6, 7, 1838 : 298°·5 : 4″·5 : pale yel. [Very little, if at all, unequal, 1850, *p* possibly smaller; the same, independent, 1855; so Walker 1863; I found *p* larger?? 1862; equal, 9 in. spec. 1871; so Hind 1846, Fr 1876; D 6, 6, 1839; so Du 1872. Sm observes that P had made Sm's 6 his companion star, and therefore must have seen it the lesser.]

35 (Σ **12** : 6·2, 7·8). 0h 9m, N 8° 9′ : 6, 8; 149°·5 : 11″·9 : wh., purpsh., 1850; Σ wh., 1836. Mgs. very differently given.

ζ (Σ **100** : 4·2, 5·3). 1h 8m, N 6° 56′ : 6, 8 : 63°·8 : 23″·4 : wh., greyish, 1839; Du both pale yel. 1869. 6 var. up to 4? Σ and Main c. p. m.

55 (Σ **46** : 5, 8·2). 0h 34m, N 20° 47′ : 6, 9 : 193°·7 :

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5″·9 : or., deep bl., 'rich specimen of opposed hues,' 1833; Σ 'egregie flava, egregie cærulea, colores insignes,' 1830; De yel., deep red, 'couleurs sûres,' 1856. [9 very small, col. indistinct, 1848, 1850; 10 m^{g}. 9 in. spec. 1871.] Fr like 10, 1876.

ϕ (Σ **99** : 4·7, 10·1). 1^{h} 7^{m}, N 23° 57′ : 6, 13 : 226°·5 : 9″ : or., flushed. [13 missed.] P *duplex*; *comes* var. ?

52. 0^{h} 26^{m}, N 19° 38′ : 6, 14 : 311° : 25″ : fine yel., deep bl. [easy, 9 in. spec. 1871].

P I 123 (Σ **138** : 7·3, 7·3). 1^{h} 30^{m}, N 7° 2′ : 6·5[1], 8 : 19°·8 : 1″·5, 1832; Schi 32°·1 : 1″·5, 1877 : creamy wh. Bin. ? Fine test, requiring beautiful weather: elong., 80; in contact, 144; divided, 250. Washington achr. *comes*, 14 (Σ's scale): 62°·8 : 22″·2. Between μ and o; but there are several similar stars around: look in finder for a long, narrow trapezium; it will be the p of the two s stars: in the telescope a 10 m^{g}. star lies near it n f: fainter *comes* s p.

51 (Σ **36** : 5, 9). 0^{h} 26^{m}, N 6° 18′ : 6·5, 9 : 82°·5 : 27″·6 : pearl wh., lilac.

100 (Σ **136** : 6·9, 8). 1^{h} 29^{m}, N 11° 57′ : 7, 8 : 78°·9 : 15″·9 : wh., pale grey. Fletcher yel., lilac, 1852. Fr ruddy, 1876. Closely n p π.

P I 85, 87. 1^{h} 22^{m}, N 7° 20′ : 7, 8·5 : 98°·7 : 68″·3 : pale yel., blsh.

42 (Σ **27** : 6·8, 10·7). 0^{h} 16^{m}, N 12° 49′ : 7, 13 : 341°·5 : 35″ : topaz, emerald; strong contrast. H 7, 9 : or., bl. 1827. [13 too small for col., 9 in. spec. 1871.] Sa bright grn., 1874. Moving.

38 (Σ **22** : 7, 8). 0^{h} 11^{m}, N 8° 12′ : 7·5, 8 : 235°·9 : 4″·8 : light yel., flushed wh. 1837; Se grn., bl. 1856; Miss

[1] Probably a mistake (K, who sees them nearly equal, as H and Σ).

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Mitchell yel., crimson mingled with yel. 1860, 1862. Σ c. p. m. Closely *f* 35, *supra.*

77 (Σ **90** : 5·9, 6·8). $1^h\ 0^m$, N 4° 16′ : 7·5, 8 : 82°·5 : 32″·1 : wh., pale lilac.

P O 251 (Σ **80** : 7, 8·2). $0^h\ 53^m$, N 0° 8′ : 8, 9 : 299°·8; 18″·4, 1832; 305°·1 : 18″·8, 1852 : pale or., clear bl. 1838; Main wh. 1869, 1870. Moving.

OΣ **20** (66). $0^h\ 48^m$, N 18° 32′ : 5·9, 7 : 60°·4 : 0″·8 : yelsh., blsh., 1861. (Bu at Mt. Hamilton 6, 6 : 191°·4 : 0″·53, 1879.)

Σ **3009.** $23^h\ 18^m$, N 3° 2′ : 6·8, 8·8 : 229°·5 : 6″·9 : v. yel., bl.

Σ **98.** $1^h\ 6^m$, N 31° 28′ : 7, 8 : 247°·9 : 19″·3 : wh.

Σ **3019.** $23^h\ 24^m$, N 4° 37′ : 7·1, 8·1 : 185°·3 : 10″·7 : wh.

Σ **186** (P I 209). $1^h\ 50^m$, N 1° 15′ : 7·2, 7·2 : 64°·7 : 1″·2 : wh., 1831. (Newcomb 325°·7 : 0″·2, 1874. Bin. In Bedf. Cat.)

Σ **155.** $1^h\ 38^m$, N 8° 51′ : 7·5, 7·9 : 332°·8 : 4″·6 : wh. (D vars. Slow motion? A little *n p o.* Beautiful field. Bu finds Ll. 3170, *n p*, double : 8·5, 9 : 98°·7 : 0″·9.)

Σ **3031.** $23^h\ 35^m$, N 5° 37′ : 7·5, 8·5 : 312°·9 : 14″·6 : wh.

Σ **3054.** $23^h\ 57^m$, N 7° 36′ : 7·5, 8·5 : 181°·5 : 33″·7 : v. wh.

Σ **122.** $1^h\ 21^m$, N 2° 55′ : 7·9, 9 : 332°·8 : 5″·8 : v. wh., bl. (Moving.)

Σ **87.** $0^h\ 59^m$, N 14° 45′ : 8, 8·5 : 193° : 6″·6 : yelsh.

Σ **74.** $0^h\ 49^m$, N 8° 46′ : 8, 9 : 301°·9 : 3″ : wh.

Σ **142.** $1^h\ 33^m$, N 14° 39′ : 8·2, 8·4 : 311°·6 : 26″·1 : yelsh. (Moving.)

[PISCES]

Σ **146.** $1^h\ 35^m$, N 9° 29′ : 8·3, 8·3 : 306°·5 : 23″·8 : wh.

Σ **82.** $0^h\ 54^m$, N 8° 52′ : 8·3, 9·3 : 303°·8 : 1″·7 : o, o.

Σ **3030.** $XXIII^h\ 34^m$, S 1° 3′ : 8·4, 8·6 : 220°·8 : 2″·5 : wh.

Σ **25.** $0^h\ 13^m$, N 15° 20′ : 8·5, 8·5 : 192°·7 : 1″·7 : o, o.

Σ **3033.** $XXIII^h\ 38^m$, N 6° 34′ : 8·5, 8·5 : 9°·9 : 3″·3 : v. wh.

Σ **129.** $1^h\ 24^m$, N 12° 2′ : 8·5, 9 : 283°·2 : 8″·4 : wh.

[ρ. $1^h\ 20^m$, N 18° 33′, and 94, both 5 m^g., form a splendid pair.]

(κ^1, κ^2. $XXIII^h\ 21^m$, N 0° 36′ : 5, 6 : fine field, containing 2 minute rubies. W. C. Bruce.)

Red Stars. [μ. $1^h\ 24^m$, N 5° 31′ : 5 : ruddy or. Buckingham].

[B 648 (F 19). $XXIII^h\ 40^m$, N 2° 49′ : 6·2, var.—Triangle 8 m^g. 5^m *f*.]

B 18. $1^h\ 10^m$, N 25° 8′ : 7 : red or.

B 2. $0^h\ 7^m$, N 0° 28′ : 9.

Vars. R. $1^h\ 24^m$, N 2° 16′ : 7·4, 8·3—below 12·5 : 345^d. Incr. quicker than decr.

S. $1^h\ 11^m$, N 8° 18′ : 8·8, 9·3—below 13 : 406^d : redsh.

T. $0^h\ 26^m$, N 13° 56′ : 9·5, 10·2—10·5, 11 : irregular.

Nebula.

(307 (♅ I 151). $1^h\ 19^m$, N 8° 55′. Round; brighter centre; 4 stars near.)

SAGITTA.

A little asterism, of much greater antiquity than might have been supposed from its size and the smallness of its components. Sweeping here magnificent: few coloured stars.

[SAGITTA]

Double Stars.

ζ (Σ **2585** : 5·7, 8·8). XIX^h 44^m, N 18° 51′ : 5, 9 : 312°·3 : 8″·6 : silvery wh., bl., 1831, 1838; 5 flushed wh., 1850; D yel., 1841, 1848, wh., 1843; De yel., 1856. C. p. m. A. G. Clark, 5 excessively close pair; Bu 157°·6 : 0″·3. Fl 9 var. in col. [small, 1876]. P Sm *comes*, 15 : 251° : 71″.

ε. XIX^h 31^m, N 16° 12′ : 6, 8 : 80°·9 : 92″·2 : faint yel., blsh.

θ (Σ **2637**, 49 App. I : 6, 8·3). Triple. XX^h 5^m, N 20° 33′ : 7, 9 (fixed, but c. p. m.), 8 : 327°·1, 226°·6 : 11″·4, 70″·1 : pale topaz, grey, pearly yel.

Σ **41**^{1} (2, 3). XIX^h 19^m, N 16° 44′ : 5·9, 6·7 : 78°·9 : 336″·2 : v. wh.

Σ **2484**. XIX^h 9^m, N 18° 52′ : 7·4, 8·9 : 218°·4 : 2″·5 : yelsh. wh., o. (Moving.)

Σ **2622**. XIX^h 59^m, N 16° 39′ : 8, 8·7 : 194°·2 : 6″ : yelsh., blsh.

[10, XIX^h 51^m, N 16° 19′, and 11, two 6 m^g. stars (Fr pale yel., silv. wh.), good object in rich field.]

[13, XIX^h 55^m, N 17° 11′ (Bu double : 6, 12 : 205°·4 : 29″), or., is *lucida* of a beautiful group, containing smaller red star, and pretty little 10 m^g. pair.]

[15, XIX^h 59^m, N 16° 45′, 6 m^g., commands another fine group. *n* a little *p*, at a few minutes' distance, is P XIX 392, 7 m^g., beautiful sapph. bl.]

[η, XX^h 0^m, N 19° 39′, 5½ m^g., yel., lies in a rich region. A circle around it of 30′ or 40′ radius will include several very pretty little 8 or 9 m^g. pairs, on different sides.]

[B beautiful pair, XIX^h 35·5^m, N 10° 17′ : 8·7, 10 : est. 315° : 20″ : fine ruby, fine bl.—$\frac{H}{O}$ II. 32.]

Var. R. XX^h 9^m, N 16° 22′ : 8·5, 8·7—9·8, 10·4 : 70^d; double *min.*

[SAGITTA]

Cluster.

4520 (M 71). XIX^h 48^m, N 18° 29′. Large and dim, hazy to low powers with $3\frac{7}{10}$ in., yielding a cloud of faint stars (H 11–16 m^g.) to higher magnifiers; interesting specimen of the process of nebular resolution. In Galaxy, rather more than 1° *s p* γ. About 1° *s p* M 71 is a beautiful low-power field, containing pair and triple group, all about 8 or 9 m^g.

SAGITTARIUS.

The stars of this constellation have a beautiful effect above the S. horizon, near the place where the Galaxy passes from sight in our latitude; but they are apt to be obscured by haze. The Milky Way is here very rich in a transparent night, but we see only the N. edge of a splendid portion of it.

Double Stars.

μ^1. Triple. XVIII^h 7^m, S 21° 5′: 3·5, 9·5, 10: 315°, 114°·5: 40″, 45″: pale yel., bl., redsh., 1835 [10 at least 9·5, 1850, 1855. Fr more than 9·5, 1876]. H another *comes*, 13: 267°: 18″. Common 5th, $18\frac{1}{4}$ in. 'Calver' spec.

54. Triple. XIX^h 34^m, S 16° 34′: 5·5, 8, 16: 42°·8, 280°: 28″·5,[1] 20″: yel., viol., bl. Sm 16 glimpsed only; H 14 and 18 [not seen]. Fr pair ± 40′ *s p*: est. 7, 7·5: 240°: 7″: yelsh. wh.

Σ **2565.** XIX^h 38^m, S 13° 31′: 8·8, 8·8: 34°·1: 5″·4: wh. (21. XVIII^h 18^m, S 20° 36′: D 5, $8\frac{1}{4}$: 292°·7: 2″·5, 1853 (Cin. 1″·9, 1879): light yel., bl. Discovered by Alvan Clark.)

[About $1\frac{1}{4}$° *s* of λ, XVIII^h 21^m, S 25° 29′ is a fine 7 m^g. triangle, with *comites* to the *s* and *f* stars.]

[1] Mistake in Bedford Catalogue for 48″·5.

[SAGITTARIUS]

(H 5112. XIX^h 16^m, S 18° 14′ : 8, 8, 8, 12 : Bu and Gore 12 not seen. Nearly equilateral with ρ^1, ρ^2.)

[Red Stars. B 505. XIX^h 27^m, S 16° 38′ : 6·5—a little p 54.]

[XIX^h 12^m, S 16° 8′ : 8.—2 pretty pairs sp; furthest in fine cluster (4481).]

Vars. R. XIX^h 10^m, S 19° 31′ : 7, 7·2—below t2 : 270^d.

S. XIX^h 12^m, S 19° 15′ : 9·7, 10·4 — below 12·7 : 230^d.

T. XIX^h 9^m, S 17° 11′ : 7·6, 8·1—below 12.

U. XVIII^h 25^m, S 19° 13′ : 7—8·3 : 6^d.

V. XVIII^h 24^m, S 18° 21′ : 7·5?—9·5?

W (γ^1). XVII^h 57^m, S 29° 35′ : 5—6·5 : 7^d, unsteady.

X (3). XVII^h 40^m, S 27° 47′ : 4—6 : 7^d.

Clusters and Nebulæ.

4424 (M 22). XVIII^h 29^m, S 24° 0′. Beautiful bright cl., very interesting from visibility of components (largest 10 and 11 m^g.), which makes it a valuable object for common telescopes, and a clue to the structure of more distant or difficult nebulæ. H makes all the stars of two sizes, 11 and 15 m^g., as if 'one shell over another,' and thinks the larger ones ruddy. Midway between μ and σ.

M 25. XVIII^h 25^m, S 19° 10′. Coarse and brilliant.

4367 (M 21). XVII^h 57^m, S 22° 31′. In a lucid region.

4388 (H VII 30). XVIII^h 6^m, S 21° 36′. Curious large undefined cloud of 10 m^g. (H 11–13 m^g.) stars; requiring low power and steady gazing; ½° s of μ^1.

4543 (M 75). XIX^h 59^m, S 22° 16′. Bright nucleus with low power. H resolvable.

4406 (M 28). XVIII^h 17^m, S 24° 56′. Not bright: H 14–16 m^g. 1° n p λ.

[SAGITTARIUS]

4510 (ℍ IV 51). XIX^h 37^m, S 14° 26′. Plan. bl. like star out of focus. E. of Rosse and d'A darker centre; H otherwise. Huggins gaseous spectrum. 2° *n*, a little *f* 54.

[4361 (M 8). XVII^h 57^m, S 24° 21′. Splendid Galaxy object; visible to naked eye. In a large field we find a bright coarse triple star, followed by a resolvable luminous mass, including two stars, or starry centres, and then by a loose bright cl. enclosed by several stars: a very fine combination. H a set of milky streaks and loops. Se suspects change, and finds the spectrum gaseous.[1]]

[4355 (ℍ IV 41). XVII^h 55^m, S 23° 2′. The Trifid neb. closely *f* M 20, a cruciform group. Very curious object; pair with minute *comes* 'where three ways meet,' dark rifts through nebulosity. Spectrum not gaseous; yet La and

[1] A little *n p μ*, XVII^h 57^m, S 18° 50′, is a spot referred to by Se as exemplifying in a high degree the marvellous structure which the great achromatic at Rome shows in the Galaxy. The remarks of this accomplished astronomer on the successive layers of stars are very curious: first he finds large stars and lucid clusters; then a layer of smaller stars, certainly below 12 m^s.; then a nebulous stratum with occasional openings. But what he says startled him, and all to whom he showed it, was the regular disposition of the larger stars in figures 'si géométriques qu'il est impossible de les croire accidentelles. La plus grande partie sont comme des arcs de spirale; on peut compter jusqu'à 10 ou 12 étoiles de la 9me à la 10me grandeur . . . . se suivant sur une même courbe comme les grains de chapelet; quelquefois elles forment des rayons qui semblent diverger d'un centre commun, et ce qui est bien singulier, on voit d'ordinaire que, soit au centre des rayons, soit au commencement de la branche de la courbe, on trouve une étoile plus grande et rouge. Il est impossible de croire que telle distribution soit accidentelle.' He mentions, besides this spot, several instances in Cygnus. Compare the spiral structure discovered by the E. of Rosse in many nebulæ; and see also Sm's remark on M 35, p. 313 *antea*.

[SAGITTARIUS]

Holden report conspicuous change. Neb. imperfectly seen by Sm as well as myself; rather low. Grand region.]

SCORPIO.

A fine constellation, little noticed by casual star-gazers, from its low altitude and short continuance above the horizon, with the additional disadvantage of its culminating during the brief summer's night. The student will do well to look out for it, and it will repay an hour or two of extra watching.

Double Stars.

α (Antares). XVI^h 22^m, S 26° 10′. This great star Sm justly terms 'fiery red:' and it is a grand telescopic object. Its tint, however, is not uniform: to me the disc appears yel., with flashes of deep crimson alternating with a less proportion of fine green. This latter mixture has perhaps been subsequently accounted for by the discovery (in 1845,[1] by Mitchel in America) of a 7 m^g. green (blue, K, P Sm) star near enough to the principal to be usually involved in its flaming rays; and forming an atmospheric rather than an optical test. Warner has seen it with $2\frac{3}{4}$ in. D, who measured it 275°·7 : 3″·7, 1864, noticed a curious proof of its independent, not contrasted green light, when it emerged, in 1856, from behind the dark limb of the Moon before its overpowering neighbour.

β. XV^h 58^m, S 19° 29′ : 2, 5·5 (Σ 2, 4) : 24°·9 : 13″·1 : pale or yelsh. wh., lilac (De ashy green). Bu 2 double : 10 : 87° : 0″·73.

ν. XVI^h 5^m, S 19° 9′ : 4, 7 : 338°·5 : 40″ : pale yel.,

[1] So generally stated, but Burg had noticed a double emersion from occultation in 1819: and Grant had discovered the *comes* in India, 1844, July 23. (*Monthly Notices*, XXIII. 1.)

[SCORPIO]

dusky. Jacob subdivided 7 into 7, 8 : 42°·2 : est. 1″·8, 1847; I have seen it easily with $5\frac{1}{2}$ in. Grover has even just separated it with 2 in. It could hardly have escaped H, or indeed Sm in 1831, if as conspicuous then as now. Bin? Bu, De and others 4 double : 7, opening rapidly.

σ. XVI^h 14^m, S 25° 18′ : 4, 9·5 : 271°·6 : 20″·5 : dusky wh., plum col.

ξ (51) *alias*, but wrongly,[1] *ξ* Libræ (Σ **1998** : 4·9, 5·2). XV^h 58^m, S 11° 2′ : 4·5, 5 : 13°·3 : 1″·1, 1838 (Se 161° 0″·4, 1866; De 183°·3 : 1″·2, 1877) : bright wh., pale yel. (D both yelsh.). Bin. Thiele 49 y : Do 96 y; measures discordant. A third star, 7·5 : 74°·2 : 7″·2, 1838 (De 70°·3 : 7″, 1870) : grey, may also be moving. [Elong?? 1851. Beautiful field.] *s* a little *f* is Σ **1999** : 7·4, 8·1 : 102°·2 : 10″·5 : wh. (some obs. bl. or purp.), yelsh. wh.—Sa 11 m^g. *f*.

P XVI 236. XVI^h 50^m, S 19° 21′ : 6·5, 8 : 230°·6 : 5″·8 : creamy wh., grnsh.

31. XVII^h 10^m, S 26° 30′ : 6·5, 11 : 330°·4 : 6″·8 : pale wh., ashy. Moving? Identical with 38 Oph.

P XVI 48, 49. XVI^h 13^m, S 19° 50′ : 8, 9 : 21°·5 : 13″·9 : dull wh., flushed. Another pair in field, P XVI 44, 45, forms with them a beautiful group. 1° *p* *ψ* Oph.

(2. XV^h 46^m, S 24° 58′ : Bu 6, 10·5 : est. 270° : 3″. O. Stone 277°·6 : 2″·5, 1877.)

(11. XVI^h 1^m, S 12° 25′ : 6, 12. Bu.—K 258°·2 : 3″·75.)

Vars. R. XVI^h 11^m, S 22° 39′ : 9? 10·5—below 12·5 : 223^d. Unsteady.

S. XVI^h 11^m, S 22° 36′ : 9·1, 10·5—below 12·5 : 176^d.

[1] From a mistake of Flamsteed's (D), followed even by Σ.

[SCORPIO]

T. XVI^h 10^m, S 22° 41′ : 7—below 10 : One appearance. See M 80.

U. XVI^h 16^m, S 17° 36′ : 9?—below 12 : One appearance.

Nebulæ and Cluster.

4173 (M 80). XVI^h 10^m, S 22° 42′. Like a comet; in a beautiful field, half-way between *a* and *β*. H calls it the richest and most condensed mass of stars in the firmament, and speaks of it as on the W. edge of a vast starless opening 4° broad; in which, however, I found many minute stars. H cl. 14 m^g. [Beautiful field.] Nearly central, or more probably between it and us, is the strange var. T, which, 1860, between May 18 and 21, had blazed out to 7 m^g. extinguishing apparently the cl., had almost faded by June 16, and has never distinctly reappeared. In field, *f* a little *n*, are two vars. R and S; the whole in singular juxtaposition.

4183 (M 4). XVI^h 16^m, S 26° 14′. Large, rather dim, resolvable, followed by a vacant starless space.[1] 1½° *p a*.

4261 (M 62). XVI^h 54^m, S 29° 56′. H fine cl., but very low.

SERPENS.

A long, rambling constellation, mixed with Ophiuchus. It contains some fine telescopic objects.

Double Stars.

a. XV^h 38^m, N 6° 48′ : 2·5, 15 : 1″·5 : 50″, 1837 (Bu 354°·5 : 58″·9, 1878) : pale yel., fine bl. [15 var? obvious, 9½ in. spec. 1867.] Sa 2½ in. achr. 1874.

δ (Σ **1954** : 3, 4). XV^h 29^m, N 10° 56′ : 3, 5 (one var!):

[1] H has remarked many vacancies of this kind. See Appendix I.

[SERPENS]

196°·2 : 2″·8, 1842 (D 191°·2 : 3″·2, 1865; Hall 190° : 3″·5, 1876) : blsh. wh., 1831—1842. De yel., ashy yel., 1853—1855; whsh. yel., ashy olive, 1856. Bin. Fine specimen of a moderately close unequal pair.

β (Σ **1970** : 3, 9·2). XV^h 41^m, N 15° 48′ : 3·5, 10 (Sa and Wa smaller) : 264°·5 : 31″ : pale bl.; [pale yel., lilac, 9½ in. spec. 1872; so Fr 1879.]

θ^1, θ^2 (Σ **2417** : 4, 4·2). XVIII^h 50^m, N 4° 3′ : 4·5, 5 : 103°·9 : 21″·6 : pale yel., gold. yel. Sm says 4·5 has been variously rated, and should be watched for var. light: this would be easy, close to so excellent a standard of comparison; but, to prevent mistakes, it must be borne in mind that θ^1, or 4·5, was *p*, 1834. Σ c. p. m. This noble pair in a very fine field lies to the naked eye in a dark space between the two streams of the Galaxy. There is a traditional misrepresentation of the latter in this region, where both streams were misdrawn and misplaced on the older globes and maps. Much fine sweeping occurs among moderate-sized stars between these branches, showing that the darkness to the naked eye is due to the absence of the unresolved background. In H's 'Outlines of Astronomy' is a very accurate description of the Galaxy, and it has been most carefully delineated by Heis and Gould.

ν. XVII^h 14^m, S 12° 43′ : 4·5, 9 : 31°·3 : 50′·8 : pale sea-grn., lilac, 1832; silvery, native copper, 1851. [9 small, 1850, 1855; so Fr 1876.]

59 (Σ **2316** : 5·5, 7·8). XVIII^h 21^m, N 0° 7′ : 5·5, 8 : 314°·2 : 3″·9 : yel., indigo bl.; H or., grn. Brightest of vicinity.

5 (Σ **1930** : 5, 10). XV^h 13^m, N 2° 14′ : 5·5, 10·5 : 39°·8 : 10″·3 : pale yel., light grey. Σ 5·5 oblong, 1836. Rapid c. p. m. Very near M 5, p. 337.

[SERPENS]

49 (Σ **2021** : 6·7, 6·9). XVI^h 8^m, N 13° 51′ : 7, 7·5 (Fr very little diff., 1876) : 318°·1 : 3″·3, 1839 (De 324°·6 : 3″·5, 1864) : pale wh., yelsh. Bin in 600 (Fl 900) y ? C. p. m. Sa minute *comes f*.

P XV 220 (Σ **1987** : 7·2, 8·7). XV^h 51^m, N 3° 45′ : 8, 9 : 324°·7 : 10″·5 : wh., grey, 1834; De 8 bl., 'sûre,' 1856. 1½° *s f ε*.

P XV 76 (Σ **1940** : 8·2, 8·7). XV^h 21^m, N 18° 36′ : 8, 9·5 : 326°·3 : 1″·7 : wh. Most difficult [not seen].

Σ **1931**. XV^h 13^m, N 10° 49′ : 6·2, 7·6 : 172°·5 : 13″·1 : wh.

Σ **2204**. XVII^h 40^m, S 13° 14′ : 7, 7·2 : 23°·6 : 14″·3 : wh.

Σ **1985**. XV^h 50^m, S 1° 48′ : 7, 8·1 : 326°·6 : 5″·4 : yelsh. wh., ash. (Fl bin ?)

Σ **2041**. XVI^h 16^m, N 1° 26′ : 7·3, 10·5 : 4°·4 : 3″·1 : yel., o. (Sa most beautiful; 10·5 bl.—17^s *p*, 11′ *n* of *σ*.)

Σ **2294**. XVIII^h 8^m, N 0° 8′ : 7·4, 7·7 : 91°·9 : 1″·1 : wh. (Closing.)

OΣ **303**. XV^h 55^m, N 13° 37′ : 7·4, 7·9 : 134°·4 : 0″·8 : Bin.

Σ **1944**. XV^h 22^m, N 6° 30′ : 7·5, 8·1 : 341°·6 : 1″·3 : wh. (Moving.)

Σ **1988**. XV^h 51^m, N 12° 50′ : 7·5, 8·2 : 266°·3 : 2″·9 : v. wh.

Σ **2347**. XVIII^h 32^m, S 0° 31′ : 7·5, 9·4 : 259°·3 : 3″·2 : yelsh., o.

Σ **2017**. XVI^h 7^m, N 14° 49′ : 7·7, 8·4 : 249°·7 : 25″ : yelsh. wh. (Moving.) [A pretty pair.]

Σ **1952**. XV^h 26^m, N 10° 2′ : 7·8, 9 : 221°·9 : 15″·9 : wh., o.

Σ **2119**. XVII^h 0^m, S 13° 44′ : 8, 8 : 17°·8 : 2″ : v. wh.

Σ **1990**. XV^h 54^m, N 22° 8′ : 8, 8·5 : 59° : 56″·2 : yelsh.

[SERPENS]

wh., 1832.—Triple; 8·5 : 209° : 3″·8, wh. [ruddy, 2 bl. 4th star, 14 : *p* a little *s*, 1879].

Σ **2250.** xvii^h 53^m, S 6° 51′ : 8, 9 : 346°·5 : 7″·7 : v. wh.

Σ **3101.** xv^h 53^m, S 2° 43′ : 8·2, 8·5 : 60°·3 : 2″ : yelsh. wh.

Σ **2324.** xviii^h 25^m, N 1° 17′ : 8·2, 8·5 : 146° : 2″·4 : yelsh. wh.

Σ **1986.** xv^h 50^m, N 10° 25′ : 8·2, 8·8 : 94°·4 : 14″·4 : wh.

Σ **2361.** xviii^h 35^m, N 3° 0′ : 8·3, 8·8 : 211°·5 : 25″·1 : wh.

Σ **1943.** xv^h 22^m, N 5° 46′ : 8·5, 9 : 153°·3 : 5″·3 : wh.

Σ **1978.** xv^h 45^m, N 15° 1′ : 8·5, 9 : 235°·2 : 15″·3 : wh.

Σ **1979.** xv^h 46^m, N 22° 50′ : 8·5, 9·1 : 247°·4 : 9″·4 : wh.

Σ **2008.** xvi^h 1^m, S 2° 17′ : 8·5, 9·2 : 58°·4 : 8″·8 : yelsh. wh., o.

Σ **1945.** xv^h 22^m, N 15° 7′ : 8·8, 9·5 : 273°·2 : 30″·7 : o, o.—Triple; 9·5 : 280°·4 : 8″·8.

Σ **1949.** xv^h 25^m, N 13° 26 : 9, 9·2 : 213°·2 : 16″·4 : o, o.

Σ **3126.** xv^h 44^m, S 2° 47′ : 9·2, 9·2 : 282°·3 : 2″·4 : o, o.

(6, Bu **32.** xv^h 15^m, N 1° 9′. De 4·6, 9·4 : 13°·2 : 2″·3, 1875. Sa yel., grey bl. Burton triple, est. 80° : 50″.)

Vars. R. xv^h 45^m, N 15° 30′ : 357^d; irregular.
S. xv^h 16^m, N 14° 45′ : 361^d; irregular : red.
T. xviii^h 23^m, N 6° 13′ : 342^d; lengthening ? : or.
Closely *s f* Cl. 4410, next object.

Clusters.

[4410 (H VIII 72). xviii^h 22^m, N 6° 29′. Very fine, with star 7 m^g. in large field; eye-object. Baxendell found var. T. among outliers; compare 4713, p. 388. Between it and *θ*, nearer the former, is a beautiful large cloud of stars, chiefly 8 and 9 m^g., a nearer part, apparently, of the Galaxy : visible to naked eye, and requiring a large field.]

[SERPENS]

[Very large subdivided group, chiefly 9 and 10 mgs. ± XVIIIh 32m, N 5° 5′.]

SEXTANS.

A modern asterism, as its name denotes, being one of the minor constellations formed by Hevelius out of unclaimed stars lying between the ancient ones.

Double Stars.

35 (Σ **1466** : 6·1, 7·2). xh 37m, N 5° 23′ : 7, 8 (De 6, 7; Du 5·5, 7) : 239°·6 : 6″·8 : yel., bl., 1834, 1839, 1849; Σ ditto, 1832, and Du, 1872 [yel., ruddy, 1852; so Fr. 1877. Much diff. as to cols. Fine field, especially if large.]

9. IXh 48m, N 5° 30′ : 7, 9, 1832 (Se 6, 7 : yel., bl., 1359) : 293°·5 : 49″·7 (Se 52″·4) : flushed bl., pale bl., 1851 [7 red, 1852 : Fr or., 1877.] Pointed at by α and π Leon.

P IX 161 (Σ **1377** : 7·9, 11·1). IXh 37m, N 3° 11′ : 8, 13 : 145° : 4″ : yelsh. wh., bl. (Moving.) [not examd.]

Σ **1371**. IXh 29m, N 4° 27′ : 8, 10·5 : 279°·8 : 7″·1 : yelsh., o. (H 10·5 dusky red; v. remarkable col.)

Σ **1470**. xh 40m, S 5° 5′ : 8·2, 8·5 : 6°·2 : 1″·4 : o, o.

Σ **1404**. IXh 58m, S 1° 6′ : 8·7, 9·3 : 292°·8 : 6″·1 : wh.

Σ **1452**. xh 30m, N 3° 14′ : 9, 9·1 : 329°·7 : 10″·1 : o, o.

(Var.? Gore, 19 (Ll 19662). IXh 58m, S 8° 59′ : Ll 4·5, Harding 5, Heis 6–7, Gore 7, and missed by several observers.[1])

Nebulæ.

2008 (ℍ I 163). IXh 59m, S 7° 7′. Very distinct, with much brighter centre, bearing magnifying unusually well.

[1] A list of 51 suspected vars. in S. Decl. is given in Gore's interesting and valuable little work, *Southern Stellar Objects*.

[SEXTANS]

2041 (H I 3, 4). x^h 8^m, N 4° 4′. Two very faint neb^e in a glorious field. H missed the fainter, though he observed the other 4 times. d'A saw 3, and called H I 3 *admodum luminosa*. Such was the working of the Copenhagen 11 in. achr.

TAURUS.

An interesting constellation, containing two beautiful groups familiar to the first beginner in stellar astronomy,—the Pleiades, and Hyades. Neither of these, however, is sufficiently concentrated to make a good telescopic object, excepting in an unusually large field. The 6 principal stars of the Pleiades are evident to any clear sight; but glimpses of more are easily attainable. Möstlin is said by Kepler to have distinctly made out 14, the relative positions of 11 being estimated with surprising accuracy in the absence of a telescope. Carrington and Denning have seen 14; even 16 are spoken of by Carl von Littrow, who says 11 are not unfrequently perceived. A beautiful triangle of small stars will be found near the *lucida*, Alcyone. (III^h 40^m, N 23° 44′.) I have noticed the remarkable absence of colour in the group, except in one minute ruby star, and an or. outlier. Wolf has charted 499 stars here down to 14 m^g.

Double Stars.

a. IV^h 29^m, N 16° 16′ : 1, 12 : 35°·9 : 107″·9 : pale rose-tint [yellow]. Es var. yel. to red. Aldebaran, in Arabic *the hindmost*, because he seems to drive the Pleiades before him. The minute attendant is a good light test. D has seen it with $2\frac{3}{4}$ in., Wa with $1\frac{7}{8}$ in.[1] My $3\frac{7}{10}$ in.

[1] It may be remarked, however, once for all, that personal equation and atmospheric conditions enter so largely into these estimates that the employment of such tests is seldom conclusive in its results.

showed it certainly, but not without much attention; 144 suited it better than 80. Bu detected a still fainter attendant at 109°·: 30″·4; a good test for large apertures. Occultations of Aldebaran are not infrequent, as it lies in the Moon's way: they are striking phænomena, and to some observers are apt to exhibit the singular optical illusion of *projection* (see p. 81).

θ^1, θ^2 (Σ 10 App. I). IV^h 22^m, N 15° 42′: 5, 5·5, 1834 (Σ 4·7, 5, 1836; Fr 4, 4, 1877; so Heis; A 4·5, 4·5) [vars ?]: 166°·7: 336″·8: pearly wh., yelsh. C. p. m.? Among Hyades; a pair to naked eye. Fr observes that Sm's description suits θ^2, θ^1.

τ. IV^h 35^m, N 22° 44′: 5, 8: 209°·8: 61″·6: blsh. wh., lilac.

88. IV^h 29^m, N 9° 55′: 5, 8·5: 300°·4: 68″·5: blsh. wh. 1832 (Fr yelsh. wh. 1876), cerul. bl.

7 (Σ **412**: 6·6, 6·7). III^h 27^m, N 24° 4′: 6, 6·5: 265°: 0″·7, 1833 (Gl 232°: 0″·4: 1873): wh., pale yel. Fl rapid bin. [Fine test; elong. 5½ in. 1861.] Triple, 11: 61°·9: 21″·8: blsh.

χ (Σ **528**: 5·7, 7·8). IV^h 15^m, N 25° 21′: 6, 8: 25°·1: 19″·3: wh., pale sky bl. or grey, 1831, 1850; Fr lilac or ruddy, 1879.

80 (Σ **554**: 6·5, 9). IV^h 23^m, N 15° 23′: 6, 8·5: 13°·9: 1″·6, 1832; 15°·2: 1″·8, 1843 (Burton and Erck 3°·3: 0″·7, 1873; Bu 7°: 0″·6, 1878): yel., dusky. [*Comes* not seen, 3$\frac{7}{10}$ in. 1851.] Measures discordant, from nebulous character of 8·5 (Fl); OΣ could not see it distinctly, in very fine air, 1872; but Fl bin. Σ c. p. m. In Hyades, about 1½° *s p* α.

φ. IV^h 13^m, N 27° 4′: 6, 8·5: 241°·8: 55″·9: light red, cerul. bl. Fr red star 7 or 7·5 m^g. ¼° *f*.

[TAURUS]

111. v^h 17^m, N 17° 16′ : 6, 8·5 : 271°·2 : 63″ : wh., lilac, 1832, 1857 [yel., lilac, 1851].

30 (Σ **452** : 4·5, 9·6). 111^h 42^m, N 10° 46′ : 6, 10 : 58°·5 : 9″ : pale emerald, purp., 1839. [colour less decided? 1858.]

118 (Σ **716** : 5·8, 6·6). v^h 22^m, N 25° 3′ : 7, 7·5; 1838 (De 4·4, 7, 1852) : 195°·9 : 5″ : wh., blsh. Fl slow bin. C. p. m. Between tips of horns, nearer *n*.

P IV 257. Triple. IV^h 52^m, N 14° 22′ : 7, 8, 10 : 303°·8, 88°·3 : 38″·9, 70″ : wh., cerul. bl., purp. 4th faint star *f*. [Beautiful.] Wa 2 more *p* and *f*.—*n f* o^1 and o^2 Orion.

62 (Σ **534** : 6·2, 8). IV^h 17^m, N 24° 1′ : 7 (Heis 6), 8·5 : 290° : 28″·6 : wh., pale purp. In a fine field.

P V 37 (Σ **680** : 6·3, 10·2). v^h 12^m, N 20° 1′ : 7, 11 : 204°·1 : 9″ : deep yel., blsh. (Bird dull red, bearing any illumination.) Last of curious series of 6 stars nearly *f* each other. The next *p* is P V 25 (Σ **674** : 6·5, 9·5) 8, 11 : 148°·4 : 10″ : bright wh., blsh. [*comes* easier than last.]

P III 213 (Σ **479** : 7, 7·9, 10). Triple. 111^h 54^m, N 22° 52′ : 7·5, 8, 12, 1835 : 128°·1, 240° : 7″·2, 60″ : wh., grey, bl. (Se col. of 8 var.) [8 more like 9 : 12 like 10, 1855; so Fr 1876.] 12 var.? South missed it, 1823. Σ rated it differently in different years; De 9·2, 1857; Du 9·4, 1871 : Johnson with 2¼ in. achr. 1875, 1879. 3° *f* Pleiades, a little *s*.

P V 20 (Σ **670** : 7·7, 8·2). v^h 10^m, N 18° 18′ : 8, 8·5 : 168°·5 : 2″·1 : blsh. 1834 (Fr yelsh., blsh., 1876).

Σ **9**[1] (κ^1 κ^2). IV^h 18^m, N 22° 1′ : 5, 6. [A pretty minute pair between them, De 11·2, 11·6 : 324°·5 : 5″.]

[TAURUS]

σ^2 σ^1 (numbered in R A; Σ 11[1]). IV[h] 32[m], N 15° 41′ : 5·2, 5·7. [This, and the previous, look like connected systems.]

Σ 12[1]. IV[h] 54[m], N 26° 31′ : 6, 7 : 158°·6 : 78″·8 : yelsh. wh.

Σ 548. IV[h] 21[m], N 30° 6′ : 6, 8 : 35°·9 : 14″·2 : yelsh., blsh. [Very pretty.]

Σ 495. IV[h] 1[m], N 14° 50′ : 6, 8·8 : 216°·1 : 3″·6 : yelsh. wh., blsh.

Σ 430. III[h] 34[m], N 4° 45′ : 6, 9 : 55°·3 : 26″·6 : v. yel., o.—Triple; 9·8 : 301°·9 : 39″·4 (37″·4, as De and Bu ?)

OΣ 118 (P V 222). V[h] 41[m], N 20° 49′ : 6·2, 7·7 : 318°·7 : 0″·6 : yelsh., o.—Triple; 7·2 : 160°·6 : 75″·5.

Σ 730. V[h] 25[m], N 16° 59′ : 6·5, 7 : 141°·8 : 9″·8 : v. wh. [7, 7·3 : yelsh., blsh., 9 in. spec. 1872; so Fr and nearly equal, 1876]. De wh., olive, 1857.

Σ 401. III[h] 24[m], N 27° 9′ : 6·5, 7 : 270° : 11″·1 : wh. [Finely grouped with Σ 7[1] *infra*.]

Σ 427. III[h] 33[m], N 28° 23′ : 6·6, 7·4 ; 208°·6 : 6″·7 : wh., blsh. wh.

Σ 785. V[h] 39[m], N 25° 53′ : 6·7, 7·7 : 348°·6 : 13″·8 : wh., blsh. wh. [Very pretty.]

Σ 535. IV[h] 17[m], N 11° 5′ : 6·7, 8·2 : 353°·9 : 1″·9 : yelsh., blsh. (Bin.)

Σ 766. V[h] 34[m], N 15° 18′ : 6·8, 8 : 276°·1 : 9″·6 : wh., blsh.

Σ 7[1]. III[h] 24[m], N 27° 19′ : 6·9, 7·4 : 233° : 44″ : v. wh.

Σ 559. IV[h] 27[m], N 17° 46′ : 7, 7 : 278°·7 : 3″ : v. wh. [A little *f* a line from α to ε.]

Σ 394. III[h] 21[m], N 20° 4′ : 7, 8 : 163°·3 : 6″·7 : yelsh., blsh.

Σ 406 III[h] 24[m], N 4° 45′ : 7, 9 : 123°·8 : 9″·3 : wh., o.

[TAURUS]

OΣ **64** (P III 165). $111^h\,43^m$, N 23° 29′ : 7, 9·9 : 239° : 3″·3.—Triple; 9 : 237° : 10″·6 (In Pleiades).

Bu 87 (P IV 53). $1v^h\,15^m$, N 20° 32′ : 7, 11 : 171° : 1″·2 : red, bl. (Sa very beautiful.)

Σ **749**. $v^h\,30^m$, N 26° 53′ : 7·1, 7·2 : 23°·4 : 0″·67 : v. wh., 1829. (Romberg 186°·9 : 0″·8, 1864. Divided by Buffham with 6½ in. 'With' spec.)

Σ **742**. $v^h\,29^m$, N 21° 56′ : 7·2, 7·8 : 246°·2 : 3″·3 : yelsh., wh., 1830. (Hall 254°·2 : 3″·6, 1876.) [A charming object, 2^m *f* M 1.]

Σ **697**. $v^h\,17^m$, N 15° 55′ : 7·2, 8·2 : 285° : 26″ : wh., blsh. wh.

Σ **523**. $1v^h\,13^m$, N 23° 27′ : 7·2, 9·2 : 165° : 10″·3 : v. wh., o.

Σ **545**. $1v^h\,20^m$, N 17° 56′ : 7·5, 9·3 : 57° : 19″·1 : wh., o. [Pretty.]

Σ **494**. $1v^h\,2^m$, N 22° 47′ : 7·7, 7·7 : 189°·9 : 5″·1 : v. wh.

Σ **686**. $v^h\,14^m$, N 23° 55′ : 7·9, 8·1 : 219°·9 : 9″·2 : wh.

Σ **414**. $111^h\,28^m$, N 19° 25′ : 8, 8 : 185°·6 : 7″·1 : wh. (Closely followed by Σ **416** rej. p. 398.)

Σ **383**. $111^h\,17^m$, N 17° 9′ : 8, 9, 120°·1 : 5″·7 : yelsh. wh., wh.

Σ **787**. $v^h\,39^m$, N 21° 16′ : 8·1, 8·5 : 78°·5 : 1″·4 : v. wh. (Bin.)

Σ **694**. $v^h\,17^m$, N 24° 51′ : 8·2, 8·2 : 4°·2 : 1″·3 : wh.

Σ **569**. $1v^h\,30^m$, N 8° 57′ : 8·2, 8·7 : 132°·8 : 7″·9 : wh.

Σ **491**. $111^h\,59^m$, N 10° 39′ : 8·2, 8·8 : 111°·4 : 2″·7 : yelsh.

Σ **740**. $v^h\,29^m$, N 21° 7′ : 8·2, 9 : 118°·8 : 21″·8 : yel., o.

Σ **776**. $v^h\,36^m$, N 25° 18′ : 8·2, 9·2 : 104°·7 : 2″·1 : o, o.

[TAURUS]

Σ **515.** IV^h 7^m, N 2° 34′ : 8·3, 8·3 : 43°·9 : 3″·5 : wh.

Σ **755.** V^h 32^m, N 23° 13′ : 8·3, 9 : 315°·7 : 6″ : wh., o.

Σ **380.** III^h 15^m, N 8° 20′ : 8·3, 9·3 : 90°·1 : 1″·2 : o, o. (Fl rapid bin.)

Σ **403.** III^h 24^m, N 19° 22′ : 8·5, 8·5 : 181°·7 : 2″·9 : wh. (Bin.?)

Σ **567.** IV^h 30^m, N 19° 14′ : 8·5, 9 : 302°·9 : 1″·4 : yel. (Bin.?)

Σ **493.** IV^h 0^m, N 5° 22′ : 8·5, 9 : 98°·1 : 1″·8 : yel.

Σ **671.** V^h 10^m, N 25° 58′ : 8·5, 9 : 125°·9 : 17″·2 : wh.

Σ **777.** V^h 36^m, N 22° 10′ : 8·7, 8·8 : 85°·4 : 4″·6 : wh.

Σ **457.** III^h 43^m, N 22° 18′ : 8·8, 8·8 : 104°·8 : 1″·3 : wh.

Σ **806.** V^h 44^m, N 17° 52′ : 8·8, 8·8 : 198°·8 : 10″·7 : o, o.

Σ **416** rej. III^h 28^m, N 19° 24′ : H 9, 10 : 44°·7 : est. 25″ : red, bl. (24^s *f* Σ **414**, p. 397.)

[ζ. V^h 30^m, N 21° 4′ : 3·5, has a little pair in field, and a curious curve of small stars *p.*]

Red Stars. 119 (F). V^h 25^m, N 18° 30′ : 4·4 (A 6·5) var?

[B 121. V^h 39^m, N 20° 38′ : 7·7 var.?]

[B 85. IV^h 44^m, N 28° 19′ : 8·1 var.?]

B 120. V^h 38^m, N 24° 22′ : 8·5 var.

Vars. λ. III^h 54^m, N 12° 9′ : 3·4—4·2 : 3^d 22^h 52^m, unsteady.

R. IV^h 22^m, N 9° 54′ : 7·4, 9—below 13 : 325^d : red.

S. IV^h 23^m, N 9° 41′ : 9·9—below 13 : 378^d; only 70^d brighter than 13.

T. IV^h 15^m, N 19° 15′ : 9·2, 11·5—below 12·8 : irregular : *n f* the site of Hind's curious (almost) vanished neb.

[TAURUS]

U. $4^h\ 15^m$, N 19° 32′ (Pair: 10, 10 : 202° : 3″·1 : *f* slightly ruddy. Disc^d. by Baxendell.

V. $4^h\ 45^m$, N 17° 20′ : 8·3, 9·0—below 12·8 : 168^d : changes rapid.

Nebulæ and Clusters.

1157 (M 1). $5^h\ 27^m$, N 21° 56′. Oblong; pale; 1° *n p* ζ on *s* horn. Crab Nebula of E. of Rosse, who considered it resolvable, with fringes, not, however, subsequently confirmed there. Se obtained a similar result. [granular, 9½ in. spec.] d'A 5½′ × 3½′, not resolved. First seen by Bevis, 1731. Its accidental re-discovery by M, while following a comet in 1758, led to the formation of the earliest catalogue of nebulæ.

[768. $3^h\ 38^m$, N 23° 20′. Nebula in Pleiades, discovered by Tempel, 1859; a faint extended somewhat triangular haze, involving, at its *n* extremity, Merope, the bright star *s p* Alcyone, the *lucida* of the group. Suspected var. but evidence conflicting. Has been seen with less than 2 in., but invisible in the 11 in. achr. at Copenhagen: possibly from want of contrast in diminished fields: d'A says there are nebulæ invisible or barely seen in great telescopes, which can be perceived easily in their finders. Wolf is certain that it has not changed since 1864. [Found readily with 5½ in. 1863, Oct. 6:—very feeble, 1865, Sept. 25:—a mere glow when star out of field, 9 in. spec. 1872, Mar. 4; 1876, Jan. 15, in presence of star, 9½ in. spec. 1881, Jan. 31.] Goldschmidt saw it as a projection from a diffused nebulosity encompassing Pleiades; so Wolf: Tempel thinks this an illusion. Common with 37 in. silv. spec. finds 3 misty patches; Pratt 2, with 8½ in. mirror.]

[TAURUS]

[896 (H VIII·8). $\text{IV}^{h}\,39^{m}$, N 18° 41′. Round wide pair.]

[977 (H VII 21). $\text{IV}^{h}\,57^{m}$, N 23° 36′. Interesting region.]

[Pretty group. ± $\text{V}^{h}\,35^{m}$, N 23° 15′.]

TAURUS PONIATOWSKII (or PONIATOVII).

A little asterism in a very rich and beautiful part of the Galaxy.

Double Stars.

P XVII 362 (Σ **2276** : 6, 7). $\text{XVIII}^{h}\,0^{m}$, N 12° 0′ : 8, 8·5, 1838 (Main 8, 8, 1861; Du 6·4, 6·5, 1868, 1871) : 257°·9 : 6″·9 : straw yel., sapph. bl., 1831, 1838; De wh., grn., 1855—6. [M^{gs}. underrated, 1850?]

Σ **2342**. $\text{XVIII}^{h}\,30^{m}$, N 4° 50′ : 5·7, 8·5 : 12° : 26″·9 : wh., o. (Bu triple; 13 : 338°·2 : 8″·9.)

Σ **2404**. $\text{XVIII}^{h}\,45^{m}$, N 10° 50′ : 5·8, 7 : 183°·2 : 3″·5 : yel., bl., cols. remarkable. (Fr 5·8 or. red, 1878.)

Σ **2375**. $\text{XVIII}^{h}\,40^{m}$, N 5° 23′ : 6·2, 6·6 : 108°·1 : 2″·2 : wh. (Slow bin.)

Σ **2330**. $\text{XVIII}^{h}\,26^{m}$, N 13° 6′ : 7·3, 9 : 176°·9 : 20″·3 : wh., o. (Moving.)

OΣ **361**. $\text{XVIII}^{h}\,38^{m}$, N 5° 32′ : 7·5, 8·2 : 172°·5 : 22″·7.

Σ **2346**. $\text{XVIII}^{h}\,31^{m}$, N 7° 26′ : 7·5, 9 : 282°·8 : 15″·4 : wh., o. (Widening; rectilinear motion.)

Σ **2329**. $\text{XVIII}^{h}\,26^{m}$, N 6° 23′ : 7·7, 9 : 43°·3 : 4″·2 : wh.

[Pair. ± $\text{XVII}^{h}\,55^{m}$, N 7° 45′ : 8, 8·5 : wide. $1\frac{1}{4}^{\circ}$ *s p* 71, 6 m^{g}. (−OΣ^{2} 164).]

[Beautiful wide group (H 4440). $\text{XVIII}^{h}\,46^{m}$, N 10° 12′ : 9·5—11 m^{g}.]

[Fine Region. ± $\text{XVII}^{h}\,59{\cdot}5^{m}$, N 4° 32′.]

[TAURUS PONIATOWSKII (OR PONIATOVII)]

[Curious Rhomboid. ± XVIII^h 20^m, N 1° 40′ : 8, 8, 10, 10.]

Nebula.

4390 (Σ Neb. 6). XVIII^h 6^m, N 6° 50′. Small, very bright, considered by Σ one of the most curious objects in the heavens; H slightly hazy; d'A a little elliptical, 5″ or 6″, blsh. grn. Gaseous. [As described, very similar, except in the absence of a feeble nucl. at the edge, to a little gas-neb. in Cygnus, XXI^h 3^m, N 41° 45′, discovered by Stephan and found independently by me 1879, Nov. 14. A search for such objects with the spectroscope has recently been undertaken by Pickering.]

TRIANGULUM.

An ancient constellation, including several good objects.

Double Stars.

ι (Σ **227** : 5, 6·4). II^h 5^m, N 29° 44′ : 5·5, 7 : 78°·8 : 3″·5 : topaz yel., grn. (Σ bl.); 'exquisite,' Sm; 'couleurs franches et admirables,' Fl.—Slow bin. ?

ε (Σ **201** : 5·3, 11·3). I^h 56^m, N 32° 42′ : 5·5, 15 : 110° : 5″ : bright yel., dusky; most delicate. Star 8m^g., deep or. 14^s *f.* [Not examined.]

P II 89 (Σ **269** : 7·5, 9·8). II^h 21^m, N 29° 22′ : 6·5, 10 : 342°·1 : 2″·3 : yel., grey. Sm wrongly P II 93, through a mistake of Σ. 6·5 var. ? Heis naked eye. Fl slow bin. ? [10 not seen.]

P II 160 (Σ **300** : 7·9, 8·1). II^h 37^m, N 28° 57′ : 8, 8·5 : 297°·8 : 2″·9 : cream-wh., 1831 [wh., yelsh. or ruddy, 1850]; Sa 6·75, 7·5, wh., blsh., 1874. Fl bin.

[TRIANGULUM]

P II 38, 39 (Σ **239** : 7, 8, 1821, 1832). $11^h\ 10^m$, N 28° 12′ : 8·5, 9, 1834 (Se 6, 7·5; De 7, 8, 1857; Heis naked eye) : 209°·1 : 14″·1 : silv. wh., 1834 [yelsh., greyish or blsh. grey, 1849, 1852 : more than 0·5 mg. diff. Closely *p* 10, 6 mg.].

Σ **285**. $11^h\ 31^m$, N 32° 54′ : 7, 7·7 : 177°·5 : 1″·9 : yel.

Σ **197**. $1^h\ 54^m$, N 34° 43′ : 7·3, 8·3 : 233°·6 : 18″·3 : wh., ashy, 1833. (De 21″·7, 1864. Rectilinear motion.) [2° *n p* β.]

Σ **246**. $11^h\ 11^m$, N 33° 53′ : 7·3, 8·5 : 122°·5 : 10″·5 : yelsh., blsh.

Σ **232**. $11^h\ 8^m$, N 29° 50′ : 7·5, 7·5 : 245°·5 : 6″·6 : v. wh. (Bin.? Closely *f* ι.)

Σ **143**. $1^h\ 34^m$, N 33° 44′ : 7·7, 9 : 319°·8 : 30″·3 : yelsh. wh., o.

Σ **137**. $1^h\ 29^m$, N 30° 43′ : 8·2, 9 : 86°·6 : 3″·4 : wh.

Σ **219**. $11^h\ 3^m$, N 32° 46′ : 8·2, 9 : 181°·6 : 11″·4 : wh.

Σ **158**. $1^h\ 40^m$, N 32° 34′ : 8·3, 8·8 : 246°·2 : 2″·1 : wh. (Slow bin.)

Nebulæ.

352 (M 33). $1^h\ 27^m$, N 30° 4′. Very large, faint, ill-defined; visible from its great size (H nearly ½° *n* and *s*) in finder, a very curious object, only fit for low powers, being actually imperceptible, from want of contrast, with my 144. Resolved by ℍ into stars 'the smallest points imaginable.' E. of Rosse, who only saw it full of knots, found the same spiral arrangement which prevails so wonderfully in many nebulæ : two similar curves, like an S, cross in the centre. —Closely *n f* is 355, a small bright round neb., d'A bl. and I or II class, though ℍ III 150. [Not seen.]

URSA MAJOR.

This familiar constellation offers a large field to the persevering observer. It must be borne in mind that it extends far beyond the region occupied by 'the seven stars;' and from the unmarked character of some parts of it, several telescopic objects will require care in their identification. It seems difficult to ascertain whence this Bear and his companion derived their preposterous length of tail. Dr. Mather, in 1712, tells a curious story, that though the Red Indians did not divide the stars into constellations, they called the stars of Ursa Major, *Paukunawaw*, that is, the Bear, long before they had any communication with Europeans.[1] H considered that in 1838 ε was the leader of the 7; but in 1847, by far, η; Fr in 1878, ε decidedly *lucida*, and sequence $\varepsilon\ \eta\ \zeta\ \alpha\ \beta\ \gamma\ \delta$.

Double Stars.

α. $x^h\ 56^m$, N 62° 24′ : 1·5, 8 ; 203°·8 : 380″·6 : yel., 1832 [8 viol., 1850; so Sa 1872]. H 1·5 var.? Huggins finds it approaching us at 46 to 60 miles per second, while β, γ, δ, ε, ζ are receding at 17 to 21 miles. Klein gives it periodical redness; Weber finds 35^d.

ζ (Σ **1744** : 2·1, 4·2). $\text{XIII}^h\ 19^m$, N 55° 33′ : 3, 5 : 147°·4 : 14″·4 : brilliant wh., pale emerald. This fine pair, which is said to have been discovered by Riccioli, and again noticed 1700, Sept. 7, by Gottfried Kirch and his scientific wife Maria Margareta, are probably travelling together through space, and in very slow orbital motion. It forms a

[1] I am informed, however, on the highest authority that in the language of the Cree Indians this word signifies 'ye are alone; isolated.' The word for *bear* is *muskwa*.

noble group with Alcor, 5 m$^{g.}$[1] 11½′ distant (the 'rider upon the horse'), and another star, 8 m$^{g.}$, which, however, is said to have been seen without a telescope. ζ, or **Mizar**, and Alcor, form a pair to the naked eye: and thus become an excellent object for a beginner, as the telescopic increase of brightness and distance admits of direct comparison; but the inversion of the astronomical eye-piece must be borne in mind, or the identity will be perplexing. ζ was the first pair photographed by Bond, and with very encouraging success.

ι (OΣ 196; Σ 3·5, 11). VIII^{h} 51^{m}, N 48° 31′: 3·5, 13: 348°: 12″, 1839 (De 356°·9: 9″·8, 1871): topaz yel., purp. H thought 13 might shine by reflected light. Buffham very dull for its size. Wa easy with low, invisible with high powers of $4\frac{3}{10}$ in. achr. [Not seen.] Slow bin., rapid c. p. m.

ξ (Σ **1523**: 4, 4·9). XI^{h} 12^{m}, N 32° 13′: 4, 5·5: 207°·5: 1″·8, 1830; 123°·5: 2″·9, 1851 (Se 86°·6: 2″·2, 1866; Bird ± 44°, 1871; K 294°·1: 1″·7, 1877): subdued wh., greyish wh. Earliest calculated bin., period about 61 y. Rapid c. p. m.

23 (Σ **1351**: 3·8, 9). IX^{h} 22^{m}, N 63° 35′: 4, 9·5: 271°·8: 23″: pale wh., grey. Bird singularly fine, from contrast; *comes* 11 m$^{g.}$ *n p.*

ν (Σ **1524**: 3·7, 10·1). XI^{h} 12^{m}, N 33° 45′: 4, 12: 147°·2: 7″·8: or., cerul. bl. [No *comes*, $3\frac{7}{10}$ in. 1852; seen by Wa $2\frac{7}{8}$ in. 1874.]

σ^{2} (Σ **1306**: 5, 8·2). IX^{h} 0^{m}, N 67° 37′: 5·5, 9·5: 262°·4: 5″, 1835; Gl 244°·8: 2″·7, 1876: flushed wh., sapph. bl. *Comes* very difficult, $3\frac{7}{10}$ in. 80; plain, 144. Sa almost certainly var., 5·5 probably so. Bin. ?

P XI 111 (Σ **1555**: 6·4, 6·8). XI^{h} 30^{m}, N 28° 27′: 6,

[1] Brightening? K. Certainly no longer the severe naked-eye test, which it used to be even in the Arabian sky.

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7 : 340°·1 : 1″·4, 1834 (Du 345°·9 : 0″·8, 1870) : pale bl. [elong. $3\frac{7}{10}$ in. 250]. Bin.? Sm. says 'it is situated in a very vacant space to the eye, . . . but to the powerful reflectors now in use, is in a very ocean of nebulæ.' [13 m^{s}. 145° : 17″ : missed, $3\frac{7}{10}$ in.] Engelmann triple, 1865; 9·7 : 142°·4 : 13″·4. Sa beautiful plum col.

P XIII 156 (Σ **1770** : 6·4, 7·9). XIII^{h} 33^{m}, N 51° 20′ : 6, 8 : 119°·9 : 1″·9 : topaz yel., livid. 2° *n p η*, on a line pointing to *ε*; the further from *η* of two adjacent stars.

57 (Σ **1543** : 5·2, 8·2). XI^{h} 23^{m}, N 40° 0′ : 6, 9 : 9°·9 : 5″·9 : lucid wh., viol.; D yel., vivid viol. 9 moving; var.? C. p. m.

65 (Σ **1579**, 20 App. I : 6, 8·3, 6·5). Triple. XI^{h} 49^{m}, N 47° 9′ : 7, 9·5, 7 : 35°·8, 115° : 3″·8, 63″·5 : bright wh., pale purp., wh. Sm suspects two latter var. and all connected. 2° *s f* χ.

P XIII 277 (Σ **1795** : 7, 10·2). XIII^{h} 54^{m}, N 53° 41′ : 7·5, 12 : 4°·9 : 6″·8 : bright wh., pale bl. 12 singularly distinct for its mag., as Sm observes. I saw it well, $3\frac{7}{10}$ in. In string of stars reaching from *ζ* towards coarse group in hand of Boötes.

P X 58 (Σ **1428** : 7·5, 7·8). X^{h} 18^{m}, N 53° 14′ : 8, 8·5 : 85° : 3″·6 : wh. Bin.?

21 (Σ **1346** : 7, 8). IX^{h} 17^{m}, N 54° 32′ : 8, 9 (Se 7·1, 8; Du 6·6, 8·2) : 310°·9 : 6″·3 : silvery wh., viol.

Σ **1561**. XI^{h} 32^{m}, N 45° 46′ : 5·9, 8 : 266° : 10″·5 : yelsh. wh., ash. [Prettily grouped.]

OΣ **235**. XI^{h} 26^{m}, N 61° 46′ : 6, 7·3 : 43°·1 : 1″ (1872) : yel., red. Rapid bin.

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Σ **1495.** x^h 52^m, N 59° 33′ : 6, 8·3 : 38°·2 : 34″·5 : yelsh. wh. (*n* of *β*.)

Σ **1415.** x^h 8^m, N 71° 40′ : 6·1, 7 : 167°·1 : 16″·7 : v. wh.

Σ **1695.** xii^h 51^m, N 54° 44′ : 6·3, 8·2 : 289°·1 : 3″·3 : wh., ash.

Σ **1520.** xi^h 9^m, N 53° 24′ : 6·5, 7·8 : 345°·3 : 13″ : wh., blsh.

OΣ **241.** xi^h 50^m, N 36° 7′ : 6·5, 8·4 : 119°·1 : 1″·4.

Σ **1559.** xi^h 32^m, N 64° 59′ : 6·7, 7·7 : 322°·7 : 2″·1 : wh., 1831 ; 7 7 ashy, 1836. (So Fr 1877.)

OΣ **200.** ix^h 17^m, N 52° 6′ : 6·7, 8·4 : 335°·2 : 1″·4 : yelsh., o. (Bin. ?)

Σ **1349.** ix^h 21^m, N 68° 2′ : 6·8, 8 : 164°·9 : 19″·2 : wh.

Σ **1402.** ix^h 57^m, N 56° 4′ : 6·8, 8 : 96° : 21″·1 : yel., blsh. (Fl star 8 m^g. near.)

Σ **1603.** xii^h 2^m, N 56° 8′ : 6·9, 7·3 : 80°·6 : 22″·4 : wh.

Σ **1362.** ix^h 27^m, N 73° 37′ : 7, 7 : 137°·3 : 4″·9 : wh.

Σ **1315.** ix^h 3^m, N 62° 9′ : 7, 7·2 : 25°·5 : 24″·9 : wh.

Σ **1600.** xii^h 0^m, N 52° 36′ : 7, 8 : 93°·2 : 7″·6 : wh.

Σ **1544.** xi^h 24^m, N 60° 20′ : 7, 8 : 89°·5 : 12″·5 : wh.

Σ **1510.** xi^h 1^m, N 53° 28′ : 7·1, 8·4 : 341°·9 : 3″·9 : wh., ashy.

Σ **1350.** ix^h 24^m, N 67° 20′ : 7·2, 7·3 : 246°·3 : 10″·4 : wh.—Triple; 8 : 210°·1 : 121″·4 : wh.

Σ **1427.** x^h 15^m, N 44° 31′ : 7·2, 7·7 : 214°·1 : 9″·5 : wh.

Σ **1553.** xi^h 30^m, N 56° 48′ : 7·3, 7·8 : 171°·5 : 5″·3 : wh.

Σ **1358.** ix^h 23^m, N 45° 11′ : 7·3, 8·8 : 152°·6 : 24″·4 : yelsh. wh., o. (Moving.—Fl star $7m^g$. *n*.)

Σ **1321.** ix^h 6^m, N 53° 13′ : 7·4, 7·4 : 48°·4 : 20″·1 : yel. (Moving.)

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Σ 1280. VIII^h 44^m, N 71° 16′ : 7·5, 7·6 : 33°·9 : 7″·4 : yelsh. (Bin. ?)

Σ 1608. XII^h 5^m, N 54° 6′ : 7·5, 7·7 : 223°·9 : 10″·6 : yelsh. wh.

Σ 1318. IX^h 5^m, N 47° 28′ : 7·5, 8·7 : 245°·1 : 3″·5 : wh., o.

Σ 1486. X^h 48^m, N 52° 45′ : 7·5, 8·8 : 102°·8 : 28″·3 : yel., o.

Σ 1312. IX^h 2^m, N 52° 52′ : 7·7, 8·2 : 147°·9 : 4″·5 : v. wh.

Σ 1293. VIII^h 51^m, N 54° 26′ : 7·8, 9 : 92°·2 : 18″·6 : wh.

Σ 1331. IX^h 11^m, N 61° 51′ : 8, 8 : 152°·6 : 1″·2 : v. wh. —Triple; 11·5 : 200°·8 : 11″·4.

Σ 1275. VIII^h 42^m, N 57° 58′ : 8, 8 : 196°·1 : 2″ : wh.

Σ 1232. VIII^h 24^m, N 66° 40′ : 8, 8·2 : 350°·2 : 31″·1 : wh.

Σ 1512. XI^h 2^m, N 63° 9′ : 8, 8·5 : 50°·7 : 9″·4 : wh. (5^m 33^s *f*, 45′ *n*, from *a*.)

Σ 1460. X^h 33^m, N 42° 47′ : 8·1, 8·1 : 168°·7 : 3″·3 : wh.

Σ 1376. IX^h 37^m, N 43° 46′ : 8·2, 8·2 : 315°·8 : 5″ : wh.

Σ 1533. XI^h 16^m, N 37° 44′ : 8·2, 8·4 : 172°·8 : 23″·1 : wh.

Σ 1820. XIV^h 9^m, N 55° 53′ : 8·2, 8·5 : 46°·7 : 2″·4 : yelsh. (Bin.)

Σ 1576. XI^h 46^m, N 31° 29′ : 8·2, 8·5 : 242°·7 : 5″·2 : v. wh.

Σ 1691. XII^h 50^m, N 58° 49′ : 8·2, 9 : 276°·5 : 19″ : wh.

Σ 1279. VIII^h 42^m, N 40° 1′ : 8·3, 8·3 : 273°·6 : 1″·6 : wh.

Σ 1570. XI^h 39^m, N 46° 17′ : 8·3, 8·8 : 48°·8 : 10″·7 : wh.

Σ 1248. VIII^h 32^m, N 62° 26′ : 8·3, 8·8 : 208°·7 : 18″·1 : v. wh.

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Σ **1630.** XII^h 13^m, N 57° 2′ : 8·3, 9 : 166°·8 : 2″·3 : v. wh.

Σ **1408.** X^h 1^m, N 73° 38′ : 8·4, 9·2 : 11°·8 : 3″·3 : wh.

Σ **1341.** IX^h 14^m, N 51° 7′ : 8·5, 8·5 : 267°·3 : 21″·1 : wh.

Σ **1381.** IX^h 43^m, N 61° 10′ : 8·5, 8·7 : 217°·6 : 1″·5 : v. wh.

Σ **1465.** X^h 36^m, N 45° 15′ : 8·5, 8·8 : 14°·4 : 2″·2 : yelsh. wh. (Bin.)

Σ **1463.** X^h 36^m, N 47° 18′ : 8·5, 9 : 258°·3 : 7″·5 : yelsh., o.

Σ **1359.** IX^h 24^m, N 56° 47′ : 8·5, 9·2 : 69°·6 : 7″·7 : o, o.

Σ **1483.** X^h 48^m, N 48° 8′ : 8·7, 8·7 : 67°·2 : 3″·3 : wh.

Σ **1250.** VIII^h 32^m, N 52° 11′ : 8·8, 8·8 : 167°·4 : 21″·7 : wh.

Σ **1525.** XI^h 13^m, N 48° 7′ : 9, 9 : 177°·7 : 2″·3 : wh.

Σ **1407.** X^h 0^m, N 65° 2′ : 9, 9·5 : 52°·5 : 4″·9 : o, o.

(γ, XI^h 48^m, N 54° 22′, has fine group in field, one coarsely double. Sa.)

Red Star. X^h 36^m, N 68° 10′ : 6·5, var? col. very fine. Fr.

Vars. R. X^h 36^m, N 69° 24′ : 6, 8·1—12 : 303^d, unsteady : reddish.

S. XII^h 39^m, N 61° 45′ : 7·7, 8·2—10·2, 11·1 : 224^d, unsteady.

T. XII^h 31^m, N 60° 9′ : 7, 8·3—12·2 : 255^d. Increase rapid.

83. XIII^h 36^m, N 55° 17′ : 5 : seen by B, 1868, Aug. 6, $=\hat{c}$; subsequently fading : fine or.

Nebulæ.

1949, 1950 (M 81, 82). IX^h 46^m, N 69° 41′. Two neb^e

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½° apart: 81 bright, with vivid nucleus, finely grouped with small stars, two of which are projected upon the haze, to which H gives nearly 15′ of length. Two little pairs *s p* make the field very interesting. The nearer is Σ **1387.** 9·5, 9·5 : 269°·6 : 8″·9—the further is Σ **1386.** 8·2, 8·2 : 296° : 2″, 1832 (K 1″·6, 1864; De 294°·2 : 1″·9, 1869): wh.—82 (Bode's neb.) curious narrow curved ray. d'A 7′ × 100″, 2 nuclei, and sparkling as if resolvable, which 81 is not. Huggins finds both spectra continuous, but deficient at the red end, like the great neb. in Androm. and others.

2343 (M 97). XI^h 8^m, N 55° 40′. Large pale plan. neb.; very remarkable object. H 2′ 40″, which at distance of 61 Cygni only, would equal 7 times orbit of Neptune. He s≡w light nearly equable, though with softened edge, and faintly bicentral. E. of Rosse on the contrary 2 large perforations (whence it has been called the 'Owl Neb.') and an indistinct spiral structure. Before 1850, there was a star in each opening; since, one only. [Much larger than Jupiter.] Huggins gas-spectrum. 2° *s f β*.

2841 (HH V 43). XII^h 13^m, N 47° 58′. Large, oval, bright, best defined at sides; nucleus *s*, d'A 10′ × 2½′ [like Androm. neb. on small scale]. Spectrum continuous.

1823 (HH I 205). IX^h 14^m, N 51° 30′. Large, oval, bright, with nucleus. d'A *illustris, prægrandis*. E. of Rosse like Androm. neb. [Dull object, $3\frac{7}{10}$ in. in fine field with 37, 6 m^g., 1½° *s p θ*. Several pretty little pairs in neighbourhood.]

2318 (HH V 46). XI^h 4^m, N 56° 19′. Large, faint, well-defined, elongated [rather curved]; small star in centre. 1° *s f β*.

2600 (HH I 173). XI^h 47^m, N 37° 39′. Large in dark nights; central blaze.

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2413 (H I 194). XI^h 20^m, N 44° 15′. Large, elongated: star-dust *p*.

1909 (H I 78). IX^h 39^m, N 72° 50′. Bright. d'A resolvable? [Last 3 not exam^d.]

(2360 (H I 270). XI^h 11^m, N 59° 26′. Bright, not large. d'A haze round star-like nucleus.)

(2362 (H I 271). XI^h 12^m, N 58° 39′. Elongated; nucleus.)

(3671 (H I 256). XIII^h 45^m, N 60° 48′. Bright; nucleus.)

(2660 (H I 223). XI^h 53^m, N 51° 37′. d'A unusual phænomenon, very unlike other neb^{se} of the region. Star 10 m^g. in centre of slender sharp-pointed ray, 4′ × 20″.)

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This constellation is distinguished by a still more inappropriate length of tail than its larger neighbour, by which, as Sm observes, it is swung round every 24 hours: at its extremity stands the most valuable star in the heavens, Polaris, the first of the following list, 1° 20′ from the polar point, which, from the precession of the equinoxes, it will approach as near as 26′ 30″ (its nearest), A.D. 2095.

Double Stars.

α (Σ **93** : 2, 9). 1^h 15^m, N 88° 40′ : 2·5, 9·5 : 210°·1 : 18″·6 : yel., dull wh., 1830, 1838, 1849; D 9·5 blsh., as I see it. Common test, but only suited for small apertures, being easy with anything much exceeding 2 in. D has proposed it as a general standard, finding that 80 on 2 in. will show it if the eye and telescope are good; he has seen it with $1\frac{3}{10}$ in. achr.; Wa with $1\frac{1}{4}$ in. Dawson has glimpsed it

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with 1 in. T. T. Smith sees it with 1¼ in. of refl. In Dorpat achr. it has been perceived by day. Two nearer companions seen by de Boë, 1869, confirmed by several others, but denied by Bu at Chicago. Peters light-passage of more than 35 y.

π^1 (Σ **1972** : 6·1, 7). $15^h\ 36^m$, N 80° 51′ : Σ 83° : 30″·1 : yelsh. (Sm yel., bl.). Moving? Easily found *n p* ζ.

OΣ **262**. $13^h\ 7^m$, N 74° 37′ : 7·3, 8·2 : 182°·5 : 28″ : wh., redsh.

Σ **2034**. $16^h\ 4^m$, N 83° 58′ : 7·5, 8 : 115° : 1″·4 : yelsh.

Σ **1583**. $11^h\ 53^m$, N 87° 39′ : 7·5, 8·5 : 282°·8 : 11″·1 : v. wh., blsh.

Σ **1798**. $13^h\ 55^m$, N 78° 59′ : 7·5, 9·3 : 16°·3 : 7″·1 : yelsh. wh., o.

OΣ **340**. $17^h\ 40^m$, N 86° 58′ : 7·8, 8·3 : 237°·2 : 31″·5.

Σ **1771**. $13^h\ 33^m$, N 70° 23′ : 7·8, 8·5 : 70°·6 : 1″·7 : o, o. (Bin.?)

Σ **2179**. $17^h\ 22^m$, N 72° 42′ : 8·2, 8·8 : 213°·3 : 5″·5 : v. wh.

Σ **1905**. $14^h\ 56^m$, N 71° 18′ : 8·3, 8·3 : 160°·1 : 3″·8 : wh.

Σ **1849**. $14^h\ 20^m$, N 77° 13′ : 8·5, 9 : 1°·2 : 1″·5 : wh.

Σ **1980**. $15^h\ 40^m$, N 81° 29′ : 8·5, 9 : 53°·9 : 10″ : v. wh.

Σ **1761**. $13^h\ 29^m$, N 72° 20′ : 8·5, 9 : 72° : 20″·1 : wh.

Σ **1928**. $15^h\ 9^m$, N 72° 54′ : 8·5, 9·2 : 277°·6 : 6″·6 : yelsh. wh., o.

Σ **3125**. $15^h\ 24^m$, N 67° 29′ : 8·7, 9 : 272°·3 : 2″·2 : o, o.

Σ **2066**. $16^h\ 25^m$, N 76° 34′ : 9, 9 : 58°·4 : 5″ : wh.

VIRGO.

A constellation especially remarkable, for those possessed of adequate optical means, on account of the wonderful *nebulous region*, in which a far greater number of these extraordinary bodies are accumulated, than in any other equal area of the heavens; HH having detected within its boundaries no less than 323. Few of them, however, are individually interesting; it is the mysterious thronging together of these objects, whatever may be their nature, that opens such a field for curiosity. They are in general so much alike, that I have only adduced a few as specimens. They are profusely scattered over this quarter of the sky; but the region more especially referred to is pretty well defined to the naked eye by the stars ϵ, δ, γ, η, and β Virg. and β Leon.

Double Stars.

ϵ. XII^h 56^m, N 11° 36′ : 3·5, 15 : 123°·8 : 229″ : bright yel., intense bl., very striking in so small an object. [15 not seen.]

γ (Σ 1670 : 3, 3). XII^h 36^m, S 0° 47′ : 4, 4 (HH 5″·7, 1790) : 77°·9 : 1″·6, 1831; 0″, 1836; 191°·6 : 1″·9, 1843; 169°·9 : 3″·8, 1858 (D 163°·6 : 4″·4, 1867; K 159°·8 : 4″·5, 1871; 338°·5 : 4″·8, 1877) : silv. wh., pale yel.; wh. the brighter, but cols. not always equally intense. Σ thought them alternately var. in brightness, with possible period of at least several years. Humboldt suggested slow axial rotation in each. Fletcher wh., yel., cols. fixed, mags. alternately var. 4, 4·5. Period under 200 y. H 143; Hind 141; Thiele 185; but none satisfactory. This wonderful pair has been widening ever since they closed up out of all telescopic reach in 1836 (except at Dorpat, where 848 still showed elongation), and a very moderate instrument will now suffice for them. Bu pair in field p, 8·5, 11 : 315°·8 : 1″·16.

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θ (Σ **1724** : 4, 9). Triple. XIII^h 4^m, S 4° 55′ : 4·5, 9, 10 : 345°·2, 295° : 7″·1, 65″ : pale wh., viol., dusky. H and South called 9 very severe test for 5 f. telescope, 1824. Glimpsed by Wa $2\frac{1}{4}$ in. 1875 ; Gore both well, 3 in.

φ (Σ **1846** : 5 2, 9·7). XIV^h 22^m, S 1° 41′ : 5, 13 : 115° : 5″ : pale yel., fine bl. [*comes* not seen, 1854; Wa $2\frac{7}{8}$ in. 1874].

o, 84 (Σ **1777** : 5·8, 8·2). XIII^h 37^m, N 4° 9′ : 6, 9 : 233°·4 : 3″·5 : yelsh., smalt bl. (Se *once* rosy) [difficult, $3\frac{7}{10}$ in.; Wa $2\frac{7}{8}$ in., 1874]. Bin. c. p. m.

17 (Σ **1636** : 6·2, 9). XII^h 16^m, N 5° 58′ : 6, 9 : 336°·2 : 19″·8 : light rose, dusky red. Σ 6 grnsh. wh. Bird wh., bl. Σ c. p. m. Sa 2 neb^{se} *f* a little *s*; brighter, 2892.

P XII 196 (Σ **1682** : 6·7, 9). XII^h 45^m, S 9° 41′ : 6·5, 9·5 : 307°·9 : 33″·5 : topaz yel., lucid purp. Closely *s p* ψ.

54. XIII^h 7^m, S 18° 11′ : 7, 7·5 : 33°·5 : 5″·7 : wh., 1839 [pale yel.? pale bl.? 1852]. Sa yelsh., redsh., 1876; Fr yel., bl. contrast, 1877. Sa star 11 m^g. *s p*.

P XIII 238 (Σ **1788** : 6·7, 7·9). XIII^h 49^m, S 7° 28′ : 7, 8·5, 1834 (Heis 6; De 6, 7, 1857) : 55° : 2″·5, 1834 (Do 67°·5 : 2″·7, 1877) : wh. [clearly divided, 80].

P XI 126 (Σ **1560** : 6, 10·2). XI^h 32^m, S 1° 46′ : 7, 12 : 280°·9 : 5″ : pale or., redsh. (Sa bl. certain, 1876). [12 glimpsed? $3\frac{7}{10}$ in.]

P XII 32, 33 (Σ **1627** : 5·9, 6·4, 1830). XII^h 12^m, S 3° 17′ : 7·5, 7·5, not quite equal, 1836 (H equal, 1785, 1786; Fr 0·5 m^g. diff. 1877) : 198°·6 : 20″·6 : silv. wh. 3° *s* from η, a little *p*.

81 (Σ **1763** : 7·5, 7·5). XIII^h 31^m, S 7° 16′ : 7·5, 8 : 39°·8 : 2″·8 : bright wh., yelsh.. 1832 (8 pale red, De 1856 ; Sa 1876; Σ, D wh.). Bin.? Sa minute bl. star *n p*.

P XIII 25. XIII^h 9^m, S 10° 43′ : 7·5, 8·5 : 62°·8 :

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42″·4 : blsh. Fr wh., bl., decided diff., 1877. Other stars in group. $2\frac{1}{2}°$ *p a*.

P XII 221 (Σ **1689** : 6·7, 9). XII^h 49^m, N 12° 9′ : 7·5, 9 : 197°·9 : 29″·1 : pale wh., sky-bl. (Sa 7·5 strong redsh. yel., 1876). 2° *p ε*, a little *n*.

P XIII 127 (Σ **1757** : 7·8, 8·9). XIII^h 28^m, N 0° 18′ : 8, 9 : 24°·1 : 1″·5, 1832 (Do 64°·7 : 2″·3, 1877) : pale wh., yelsh. [elong? 1851]. (Morton triple; 11·5 : est. 160° : 40″.) Closely *n p ζ*.

P XIII 171 (Σ **1775** : 7, 9·7). XIII^h 37^m, S 3° 40′ : 8, 10·5, 1830 : 336°·3 : 30″ : light or., pale lilac. [10·5 seen much out of focus with strong moon, 1852; Fr more like 9·5, 1877.]

Σ **1604**. XII^h 4^m, S 11° 11′ : 6·5, 9 : 93°·3 : 12″ : wh., 0.—Triple; 7·8 : 96°·9 : 58″ : wh. (Moving.)

Σ **1904**. XIV^h 58^m, N 5° 56′ : 7, 7 : 346°·4 : 9″·6 : v. wh.

Σ **1677**. XII^h 39^m, S 3° 12′ : 7, 8 : 348°·4 : 15″·9 : yelsh. wh.

Σ **1575**. XI^h 46^m, N 9° 28′ : 7, 8 : 209°·8 : 30″·6 : yelsh. wh.

Σ **1764**. XIII^h 32^m, N 3° 0′ : 7, 8·7 : 31°·7 : 16″ : yel., ash.

Σ **1881**. XIV^h 41^m, N 1° 30′ : 7, 9·3 : 357°·9 : 3″·6 : v. wh., ash.

Σ **1740**. XIII^h 18^m, N 3° 20′ : 7·1, 7·2 : 76°·3 : 27″·3 : wh.

Σ **1734**. XIII^h 15^m, N 3° 34′ : 7·2, 7·9 : 198°·1 : 0″·7 : wh., 1830. (Gl 192°·6 : 1″·1, 1874; Se 7 wh., 8·2 changeable!).

Σ **1649**. XII^h 25^m, S 10° 23′ : 7·2, 8 : 194°·1 : 15″·2 : wh.

Σ **1719**. XIII^h 1^m, N 1° 10′ : 7·3, 7·8 : 3°·1 : 7″·2 : v. wh., yelsh. wh.

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Σ **1742.** XIII^h 18^m, N 2° 0′ : 7·4, 7·9 : 351°·1 : 1″·3 : yelsh. wh.

Σ **1690.** XII^h 50^m, S 4° 11′ : 7·4, 8·9 : 149°·8 : 5″·9 : wh., blsh.

Σ **1647.** XII^h 24^m, N 10° 23′ : 7·5, 7·8 : 202° : 1″·2 : wh. (Fl bin.)

Σ **1619.** XII^h 9^m, S 6° 35′ : 7·5, 7·8 : 287°·6 : 7″·8 : wh.

Σ **1668.** XII^h 35^m, N 9° 30′ : 7·5, 8 : 196°·9 : 1″·7 : v. wh.

Σ **1635.** XII^h 15^m, S 10° 46′ : 7·7, 8·7 : 173°·5 : 13″·4 : wh.

Σ **1807.** XIV^h 5^m, S 2° 44′ : 7·8, 8 : 25°·8 : 7″·1 : yelsh. wh.

Σ **1781.** XIII^h 40^m, N 5° 43′ : 7·8, 8·2 : 240°·4 : 1″·4 : yelsh. wh. (Bin.)

Σ **1819.** XIV^h 9^m, N 3° 41′ : 7·9, 8 : 84°·9 : 1″ : yelsh., 1830. (De 21°·3 : 1″·2, 1874. Bin.?)

Σ **1591.** XI^h 55^m, N 0° 19′ : 8, 8 : 353°·8 : 53″·8 : yelsh. wh.—Triple; 12 : 50° : 20″.

Σ **1659.** XII^h 29^m, S 11° 21′ : 8, 8·1 : 351°·9 : 27″·1 : v. wh.—Triple; 11 : 68°·9 : 30″·9. (Moving.)

Σ **1686.** XII^h 47^m, N 15° 41′ : 8, 8·2 : 187°·6 : 5″·4 : wh. (Heis in Leo.) Vars.?

Σ **1605.** XII^h 4^m, S 1° 31′ : 8, 8·5 : 278°·4 : 23″·5 : wh.

Σ **1580.** XI^h 49^m, N 4° 14′ : 8, 9 : 261° : 8″·8 : wh.

Σ **1869.** XIV^h 36^m, S 5° 26′ : 8, 9 : 132°·6 : 26″ : wh.

Σ **1799.** XIII^h 58^m, S 5° 57′ : 8, 9·2 : 293° : 4″ : wh., blsh.

Σ **1738.** XIII^h 17^m, S 14° 18′ : 8·2, 8·3 : 283°·5 : 4″·1 : wh.

Σ **1593.** XI^h 57^m, S 1° 47′ : 8·3, 8·3 : 18°·2 : 1″·4 : o, o.

[VIRGO]

Σ **1805.** XIV^h 4^m, N 4° 35′ : 8·4, 8·5 : 30°·5 : 4″·6 : wh.

Σ **1661.** XII^h 30^m, N 12° 4′ : 8·5, 8·5 : 226° : 2″·6 : wh. (Fl bin.?)

Σ **1681.** XII^h 43^m, N 4° 28′ : 8·5, 8·5 : 193°·5 : 8″·5 : wh.

Σ **1618.** XII^h 9^m, N 10° 41′ : 8·5, 8·5 : 244°·7 : 25″·8 : wh.

Σ **1628.** XII^h 13^m, N 12° 28′ : 8·5, 8·7 : 239°·3 : 9″·3 : wh.

Σ **1665.** XII^h 32^m, S 4° 40′ : 8·5, 9 : 97° : 8″·8 : wh.

Σ **1790.** XIII^h 50^m, S 4° 1′ : 8·6, 8·7 : 240°·8 : 5″·3 : wh.

Σ **1842.** XIV^h 21^m, N 4° 14′ : 8·7, 8·7 : 10°·9 : 2″·8 : wh. (Bin.?)

Σ **1568.** XI^h 37^m, N 1° 26′ : 8·9, 9·1 : 221°·3 : 9″ : o, o. Vars.?

Σ **1773.** XIII^h 35^m, N 8° 13′ : 9, 9 : 209°·8 : 27″·9 : o, o.—Triple; 9·5 : 102°·4 : 57″·1.

Σ **1712.** XII^h 58^m, N 10° 6′ : 9, 9·4 : 336°·6 : 8″·6 : o, o. (τ. XIII^h 56^m, N 2° 7′ : 4, 9 : 290° : 79″·3; South, 1823.)

Red Star. B 277. XII^h 19^m, N 1° 27′ : 8·1. d'A extraordinary spectrum, ceasing at green.

Vars. R. XII^h 32^m, N 7° 39′ : 6·5, 7·5—10, 10·9 : 145^d, unsteady.

S. XIII^h 27^m, S 6° 35′ : 5·7, 7·8—12·5 : 374^d : or.[1]

T. XII^h 8^m, S 5° 22′ : 8, 8·8—below 13 : 337^d. Increase rapid : red.

U. XII^h 45^m, N 6° 12′ : 7·7, 8·1—12·2, 12·8 : 207^d, unsteady.

[1] Said to show especially a feature of several vars.—a striking twinkling at times, particularly on the point of diminution.

[VIRGO]

V. XIII^h 22^m, S 2° 33′: 8, 9—below 13 : 251^d.

W. XIII^h 20^m, S 2° 45′ : 8·7, 9·2—9·8, 10·4 : 17^d.

X. XI^h 56^m, N 9° 45′ : 7·8?—below 10. Vanished?

Z. XIII^h 28^m, S 12° 36′ : above 5—8? pointed out by Schm, 1866, but mentioned by Persian astronomer Sûfi, 10 cent. — Bu double, 6, 6·5 : 81°·2 : 0″·47. [How does this vary?]—Minute *comes*.

Nebulæ.

3182 (M 60). XII^h 38^m, N 12° 13′. Double; *p* extremely faint [not seen]. In large field with 3155 (M 59) *n p*, 3171 (H II 70) *s p* [like a hazy star].

2786 (M 98). XII^h 7^m, N 15° 34′. Long ray, H 10′; d'A nucleus.

3021 (M 49). XII^h 24^m, N 8° 40′. Bright; d'A *illustris*, *grandis*, and resolved. [Faint haze in beautiful position between 2 stars 6 m^g. Bright open pair *s*.]

3049 (M 88). XII^h 26^m, N 15° 5′. Long, pale; d'A 7′ × 1½′; nucl. In wonderful nebulous region, marked to eye by ϵ, δ, γ, η, β, and β Leon. H ray 8′ × 1′. E. of Rosse spiral? [Marvellous region as swept with 64; identification difficult.]

2878 (M 61). XII^h 16^m, N 5° 8′. Faint; bright centre. E. of Rosse spiral.

3132 (H I 43). XII^h 34^m, S 10° 57′. Long. H 5′ × 30″, nucl., and dark cleft? [Beautiful low-power field; fine and singular 7 m^g. group *n p*.] ± 1° *p*, 30′ *s*, small triangle reversed in larger one; Wheeler, N.Y.

2806 (H I 35). XII^h 10^m, N 13° 49′. Long, shuttle-

[VIRGO]

like, nucl. E. of Rosse 15′.—2838 (M 99) *f*, 1¼° *n*. See below.

3274, 3278 (H II 74, 75). XII^h 47^m, N 11° 53′. In one field. 3278 like paper kite [beautifully grouped with 3 stars]; d'A and E. of Rosse long bright ray, nucl. [Easily found a little *p* P XII 221, which is near *ε*.]

3900 (H I 70). XIV^h 23^m, S 5° 26′. Small. H resolved, stars 19 m^g. d'A beautiful bl., with red star 8 m^g. *s f*. [Prettily grouped.]

2838 (M 99). XII^h 13^m, N 15° 4′. E. of Rosse wonderful spiral. Key resolvable 18 in. 'With' spec. So d'A.

2961 (M 86). XII^h 20^m, N 13° 36′. H very bright, resolvable? 2991 and 2994 (H I 28, 1; 2) *n f*. In this neighbourhood Lowe sees 7 neb^e in large field with fine 15½ in. Calver spec.

(3075 (H I 31). XII^h 28^m, N 8° 21′. H very bright.)

(3227 (H I 39). XII^h 42^m, S 5° 9′. H very bright.)

(3229 (H I 129). XII^h 43^m, S 8° 1′. H very bright.)

(4045 (H I 128). XV^h 0^m, N 2° 5′. H very bright.)

VULPECULA.

A little modern asterism, in which Hevel, who arranged it, perceived a new star in 1672, visible for only 2 years, and not since identified. According to Chacornac, who has recorded many such changes, they are more frequent, even in modern times, than has till of late been suspected; the improvement of catalogues enabling us to discriminate between the 'mistaken entries' of the earlier observers, and real alterations.—Grand sweeping; few coloured stars.

[VULPECULA]

Double Stars.

P XIX 320, 321 (Σ 48 App. I : 6·7, 6·8). xix^h 48^m, N 20° 1′ : 7, 7, 1834 (Main 6, 6·3, 1866) : 147°·6 : 42″·7 : wh. Another pair (Σ **2595** rej.) *p*, followed by a minute star, 5½ in. makes up a pretty group.

P XIX 415 (Σ **2631** : 8, 9·4). xx^h 2^m, N 20° 45′ : 8, 10 : 340°·5 : 4″·5 : pale wh. [redsh., 1864], sky-bl. Se moving? 1° *p* *θ* Sag.

P XX 113. xx^h 18^m, N 23° 41′ : 8, 14 : 222°·4 : 45″ : blsh. wh., indigo; intense to averted eye [not exam^d].

Σ **2445** (1). xix^h 0^m, N 23° 8′ : 6·3, 8 : 263°·5 : 12″·1 : v. wh., ashy.

Σ **2769**. xxi^h 5^m, N 21° 58′ : 6·5, 7·5 : 300°·8 : 17″·8 : wh., 1830. [7·5 blsh., 9 in. spec. 1871; so Fr 1876.]

Σ **2455**. xix^h 2^m, N 21° 58′ : 7·2, 8·3 : 144°·5 : 4″·9 : v. wh., o. (Moving.)

Σ **2655**. xx^h 9^m, N 21° 52′ : 7·5, 7·5 : 3° : 6″·1 : wh.

OΣ **388**. xix^h 47^m, N 25° 32′ : 7·6, 7·6 : 140°·5 : 3″·7. —Triple, 8·8 : 139°·1 : 26″·6.

Σ **2515**. xix^h 20^m, N 21° 17′ : 8, 9 : 18°·3 : 18″·7 : v. wh., o. (Moving.)

Σ **2692**. xx^h 26^m, N 26° 5′ : 8, 9 : 302° : 25″·7 : wh

Σ **2698**. xx^h 29^m, N 27° 42′ : 8·1, 9 : 305°·6 : 4″·1 : v. wh.

Σ **2724**. xx^h 39^m, N 23° 30′ : 8·2, 8·3 : 325°·7 : 2″·5 : o, o.

Σ **2761**. xxi^h 2^m, N 24° 0′ : 8·7, 9·2 : 112°·2 : 5″·4 : v. wh.

(2 (Bu **248**). xix^h 13^m, N 22° 48′ : De 5·8, 9·6 : 124°·1 : 1″·8 : wh., bl.)

[VULPECULA]

[Curious Field, ± XIX^h 53^m, N 28° 20′.]

[Quadruple in line, ± XVIII^h 56^m, N 27° 43′.]

[Triplet and Group, ± XX^h 25^m, N 28° 32′. In Cyg.?]

[4559 (H VIII 20). XX^h 7^m, N 26° 7′. Brilliant group round 20, with 18 and 19 as outliers—all 6 m^g.]

Vars. 11. XIX^h 43^m, N 27° 1′ : 3—? Anthelm 1670–72. Irregular.

R. XX^h 59^m, N 23° 21′ : 7·5, 8·5—12·5, 13 : 137^d.

S. XIX^h 43^m, N 26° 59′ : 8·4, 8·9—9, 9·5 : 67^d.

Nebula.

Some of my readers may perhaps feel that I have allotted an undue proportion of space to minute and inconspicuous objects. It may be so. I may have erred in supposing that others might receive as much pleasure as myself from their contemplation: yet a multitude, especially of the minuter pairs, have been passed by, as well as a great mass of remarks on the beauty or singularity of those which have been selected. But, should I have failed in communicating to others a portion of my own interest as to some parts of this list, it will be closed with a nebula which I think will not be found disappointing.

4532 (M 27). XIX^h 54^m, N 22° 23′. The 'Dumb Bell' Nebula, just visible with a 1¼ in. finder. In a rich field we find two oval hazy masses in contact, of which *p* seems to me the brighter, as it did to H. His reflector failed to resolve it, but showed the dark notches (which, as Darby remarks, are usually represented too deep) filled in and made protuberant by faint luminosity, converting the whole figure into an ellipse. The Earl of Rosse's 3 f. speculum was thought to reach its starry components: his 6 f. surrounds it with an

[VULPECULA]

external ring having a neck like a retort. Bond's achr. also seemed to resolve it, but there, as in d'A's figure, the form shown in small instruments is lost. The minute stars in it, of which I picked out two or three with $5\frac{1}{2}$ in. achr. and 8 in. silvered glass, and Denning sees 7 with 10 in. spec., are admirable tests for superior telescopes. Ingall has claimed 18 with $5\frac{1}{2}$ in. dialyte, from keenness of vision, and Se has drawn many more. They seem, however, to be merely part of the host of the Galaxy; for Huggins finds there, by simultaneous comparison, nothing but luminous gas—possibly nitrogen! And here the magnificent apostrophe of Kepler, which closes his speculations on the habitability of our own Sun, may well express our feelings, and form at the same time a most appropriate conclusion to the varied scenes which have passed in review since we commenced these pages:—

'Abrumpo consultò et somnum et speculationem vastissimam: tantum illud exclamans cum Psalte Rege:

'Magnus Dominus noster, et magna virtus ejus, et sapientiæ ejus non est numerus: laudate eum cœli, laudate eum Sol, Luna, et Planetæ, quocunque sensu ad percipiendum, quâcunque linguâ ad eloquendum Creatorem vestrum utamini: laudate eum harmoniæ cælestes, laudate eum vos harmoniarum detectarum arbitri: lauda et tu anima mea Dominum Creatorem tuum, quamdiu fuero: namque ex ipso et per ipsum et in ipso sunt omnia, καὶ τὰ αἰσθητὰ καὶ τὰ νοερά; tam ea quæ ignoramus penitus, quam ea quæ scimus, minima illorum pars; quia adhuc plus ultra est. Ipsi laus, honor, et gloria in sæcula sæculorum! AMEN.'

APPENDIX I.

ADDITIONS AND CORRECTIONS.

The Telescope.—After very careful trial, Franks concludes that the light of a 6½ in. silvered speculum is about equal to that of a 5 in. object-glass.—For his very interesting comparison between an achromatic and reflector, side by side, see 'English Mechanic,' 1879, June 20.—Chloride of calcium, well dried from time to time, has been recommended as a valuable absorbent of moisture in an observatory, especially if silvered mirrors are used. The film should on no account be touched when there is the least cloud of damp upon it. A tin cap, fitting closely into the cell, and as near the face of the mirror as possible, is a most effectual preservative. The following directions for silvering mirrors may be useful; they are not identical with those published by Browning or Calver in their pamphlets, but answer admirably in practice (Fr):—

Prepare 4 solutions:—A. 350 grs. silver nitrate in 10 oz. water: B. 524 grs. ammon. nitrate in 10 oz. water: C. 2 oz. caustic potash (pure by alcohol) in 10 oz. water: D. ½ oz. lump sugar in 5 oz. water, add 32 grs. tart. acid, and boil for 10m; when cold, add 1 oz. methylated spirit and sufficient water to make 10 oz. All water used for above must be *distilled*. Clean mirror with nitric acid, rinse thoroughly, and place face downwards in dish of dist. water. Leave everything together, mirror, dishes, chemicals, water, &c., in the room you intend silvering in, for 24 hours undisturbed; this equalises temperature, which is of importance. When ready take a large beaker, pour in silver sol., and then am. nit., in equal parts. Now slowly add the potash, but stop directly there is a dark brown ppt.,[1] which does not re-dissolve on stirring. Clear with more am. nit., and add potash and am. nit. alternately until former is exhausted. Add now a few drops of silver to get rid of free am., and allow ppt. to subside before decanting into silvering vessel, which may be of white glazed earthenware. Add sugar sol., and stir well. The colour of sol. will rapidly change, from yellow, through various tints of brown, to inky black. When this stage is reached, gently immerse the mirror, one edge first, and gradually lower the other until level, thus avoiding air-bubbles. The mirror may be held by a strip of wood fastened with pitch or cement to the back, and projecting at each end to rest upon rim of dish. The face of mirror should be 1 inch from bottom of dish when in place. The silvering being completed (which will take from 10 to 20m, according to temperature) remove mirror and rinse the brilliant film with plenty of water, finishing with distilled, and set on its edge on blotting paper to dry, afterwards polishing in the usual manner. The quantities given are sufficient for a 12 in. speculum; and the above process was communicated to the writer by Calver.

See also a letter by Brashear, 'English Mechanic,' June 11, 1880.

The Sun.—Minute observation is often difficult from the agitation caused by heat; hence large instruments lose much of their advantage;

[1] Precipitate.

and the time of day is not immaterial. Löhse with the great Bothkamp achr. found the air becoming unsteady by 11^h. Definition is often excellent through a fog dense enough to answer as a screen. Where the expense of a second mirror would not be an objection, an unsilvered speculum would be admirable, especially if aided by a similar 'flat,' as suggested by D, the back of which might be worked concave (an idea of H's) to avoid a double image.—Spörer's later value of the rotation is $24{\cdot}54^d$; and from his own and Carrington's observations he prefers a spot-period of 11·328 y.—Vogel, 1873, gives the limb but $\frac{1}{8}$ light of centre.—Langley finds the nuclei, when entirely insulated from all surrounding light, 'not black, not even dark . . . but brilliant, with a violet-purple light . . . dazzlingly vivid . . . like that of a violet star.'—The most extraordinary known instance of the energy of the solar processes has been published while these sheets were in the press. Prof. Young, 1880, Oct. 7, observed a great prominence on S.E. limb, which in less than 1^h ascended from 3′ or 4′ to 13′, extending then beyond 350,000 miles, or more than $\frac{1}{4}$ the Sun's radius, from the limb.

Mercury.—From the present position of its orbit, Fr remarks that he is best observed in the autumn mornings and spring evenings.—Schr is said to have seen him with naked eye in full daylight, and the *lumière cendrée* on the dark side. —Winnecke suspected dark spot in quadrature, 1878.—The transit of 1881, Nov. 7, will not be visible in Europe.

Venus.—Elger saw dichotomy, 1873, Feb. 12, 9^d before greatest elongation; and phosphorescence repeatedly, 1872; Sa, the latter in both years.

The Moon.—The clefts near *Triesnecker*, p. 102, omitted in Lohrmann's Topographie, are partially shown in his Map.—The terminator returns nearly to the same position after 443 and 1447 days.—Denning has seen the crescent at $20^h\ 28^m$.—Ne once witnessed an appearance in *Plato* (see p. 110) resembling a fog, which covered the whole interior at sunrise and gradually disappeared: it seemed like a hazy border of perhaps 15″ to the true shadow, hiding all beneath it till it cleared away.—Newcomb infers, from the occultation of stars, that the density of the lunar atmosphere cannot equal $\frac{1}{400}$th part of our own.

Mars.—Trouvelot has seen *Deimos* several times with $6\frac{3}{10}$ in. achr. but only with the greatest attention; brighter but less sharp than *Enceladus*, which he has glimpsed.

Jupiter.—During the recent appearance the oval markings at the equator were irregular; spots were abundant, not merely the great red patch (the commencement of which is possibly traceable in the E. of

Rosse's views in 1873), but occasionally brilliant or very dusky specks, some of which gained in a very singular manner (as Denning and several others remarked) on the red spot, while the rate of the latter, according to Fr, has not been sufficiently uniform to deduce a perfectly satisfactory rotation.—*Satellites.* Sa sees I yelsh. wh., II yel., III ruddy yel., IV decided bl.—Bond, 1848, Mar. 18, III entered disc very bright; 20^m later hardly perceptible; a little after as dark spot; then for $2\frac{1}{2}^h$ perfectly black and nearly round.—Prince, 1863, Apr. 26, II projected on disc at least 30^s before occultation.—Kidd, 1872, Oct. 16, saw II through limb (or possibly projected?); this was also observed at Stonyhurst with I, 1880, Oct. 10; and at Greenwich with III, Nov. 28.—Mrs. McCance, 1878, Oct. 12, saw II, III, IV with naked eye as one.—At Stonyhurst, 1879, Dec. 8, I was only just visible for more than $\frac{1}{2}^h$ after transit, though glare of planet cut off, and other sats. well seen.—Several dark transits of I were recorded in 1880: at Stonyhurst, Nov. 3, its shadow exceedingly faint; that of III very small. Noble and Campbell, Oct. 18, shadow of I black, II brown; Elger, II unusually light then, but much lighter, hardly noticeable, Dec. 21.

Saturn.—Encke's division is well shown (with another, if not two, on B) in photographs of drawings taken at Parsonstown, 1860; though Mitchel could never see it with most beautiful definition in the 11 in. Cincinnati achr. (since refigured and improved; a suggestive circumstance with reference to such comparisons). Hall at Washington was not more successful than Trouvelot.

Neptune.—The satellite was not held *steadily* by D, as stated at p. 187. Sa has caught it with a $6\frac{1}{2}$ in. silv. mirror: it is far brighter *p* than *f* the planet.

P. 2, *note.* Sa finds from close trial light of $6\frac{1}{2}$ in. silv. refl. equal to that of 6 in. achr.

P. 14. Ammonia should not be used on lacquered brass.

P. 60, *line* 10, *for* 9·38 *read* $9\frac{1}{3}$.

P. 94, *line* 19, *for* It *read* Posidonius.

P. 178, *line* 4, *for* $26\frac{1}{2}$ *read* 26; *et alibi.*

P. 188, *line* 20, *after* way *add* ?

Symbols omitted. o, nothing recorded.—OΣ² (OΣΣ) = OΣ's Poulkova Cat. Part II.—Cin = Cincinnati Observations with 11 in. achr.

OΣ's measures are taken from the Poulkova Observations, Vol. IX., to which he has since published corrections. His scale, identical with his father's at 7 m., diverges gradually till Σ 12 = OΣ 11·35. Bu's scale = H's in earlier observations, Σ's in later ones. A and Heis's mags. are not subdivided decimally.

A few objects in the Bedford Catalogue, omitted in the earlier impressions, have been inadvertently placed among the additions from Σ.

Andromeda.—γ. p. 214, *for* Gl 10′ *read* Gl 10″.—μ. p. 214, *add* Bu 2ᵈ *comes*, 13 (Σ): 314°·4: 37″·3. Test for great apertures.—p. 214, *line* 5 *from bottom*, *for* in *read* in. (inch).

Antinous.—37, p. 221, *omit* Es: and query whether this triple belongs here.—26, p. 221, *for f read p*: the triple is H 881.

Aquarius.—ω², p. 225, *add* Cin 84°·5: 5″·7.—35, p. 225, *add* Cin 58°·9: 1″·6.

Aquila.—P XVIII 302, p. 229. Sa finds from examination of very numerous authorities that the 3ᵈ star has been noticed only by Sm and (independently) by myself, 1873, Sept. 26, Oct. 24.—Σ **2447**, p. 230, *after* yelsh. *add* o.—Bu **142**, p. 230, *add* Cin 319°·6.—Σ **2670**, p. 231, 10·7 measured from 8·7.—ζ, p. 231, *for* $9\frac{6}{10}$ *read* $9\frac{4}{10}$.—Pair, p. 232, ± xxʰ 16ᵐ &c. is Σ **2664** Delph.—p. 232, *add* (4487 (H III 743). XIXʰ 13ᵐ, N 6° 20′. Large round faint neb. H plan. E. of Rosse ring or spiral.

Argo.—Bu **334**, p. 233, *for* 12″ *read* 2″.

Aries.—λ, p. 235, *for* 1863 *read* 1868.—P I 222, p. 236, is Σ **196**.—Σ **175**, p. 237, *add* Rectilin: motion.

Auriga.—OΣ **103**, p. 238, *for* 9 has *comes* &c. *read* 8 has double *comes*, 13 and 14: 2″.—Σ **941**, p. 239, *add* Se red, bl., 'bei colori e certi,' but reversed from Σ.—Σ **736**, p. 239. The *place* in parenthesis belongs to Σ **737**, p. 241.—Σ **666**, p. 240, *add* Σ suspected relative, Se (who speaks of beautiful group) absolute variation:—in field with 16 Es a pretty coloured pair.—Σ **861**, p. 240, *add to* 7 8; 14°·7: 67°·1.—Σ **808**, p. 241, De *comes* 11·5: 164°·5: 2″·7.—1295 (M 37), p. 242, *add* E. of Rosse 'wonderful loops and curved lines of stars,' first remarked by d'A.—1067, p. 242. d'A thinks a red star here (B 103), var.—p. 242, *add* 1114 (H VII 39). vʰ 20ᵐ, N 35° 13′. d'A very large cl. of minute stars arranged in curves.—17, 18, 19, p. 242, *add* Fr *comites* to 18 and 19. forming curious rhomboid.

Boötes.—39, p. 244, *add* D both more usually pale yel.

Camelopardus.—35, p. 249, *add* De 39″·4, 1867. Σ **362**, p. 250, *for* wh. *read* wide.

Cancer.—p. 255, *add* α. VIII^h 52^m, N 12° 19′: H 4·5, 20; Σ *subtilissima*: 326°·5: 11″·6: Sa wh., red; a lovely object.

Canes Venatici.—Σ **1768**, p. 256, *for* 1831 *read* 1863.

Canis Major.—30, p. 260. Pair *np* discovered by Ll. B first described colours and suspects vars.—Σ **1031**, p. 260, *add* H triple; 14. 351°·8: est. 12″.—p. 261, *add* σ (F 22) VI^h 57^m, S 27° 46′: 3·6, Gould var? and excessively red.—p. 261, *add* [Very fine or. star (Ll 12758), 7 m^s., ± VI^h 33½^m, S 12° 55′].

Canis Minor.—α, p. 261, *add* Bu's later measure of *comes* to Bird's pair, 335°·2: 30″·5, 1880.

Capricornus.—ρ, p. 264, *add* Cin 172°·9: 2″·9, 1877.

Cassiopea.—Σ **3038**, p. 268, *add* H both very red, almost ruby.—Σ **188** rej., p. 268, *for* I^h 50^m, N 62° 19′ *read* I^h 51^m, N 62° 20′.

Cepheus.—P XXII 11, 12, p. 271, for Σ 7·2 *read* Σ 7·2, 8.—Garnet star, p. 274. This is not μ of A, or B.A.C.—Var. T, p. 274, *for* 68° 0′, *read* 67° 54′.—Var. U, p. 274. According to Gould (*Uranom. Argent.* p. 259) a still more rapid change is found in R *Muscæ* in the S. hemisphere, 6·6 - 7·3 or 7·4, in 21^h 20^m. (The student of variable light should refer to Gould's admirable *Uranometria Argentina*, which includes several constellations visible in Europe.)

Cetus.—42, p. 276, *insert*) after '1863,' and (before 'Hall.'—p. 276, Σ **218**, cols. from Sm.—p. 277, Bu **110**, *add* Moving.—p. 278, *add* (351 (H II 4) I^h 27^m, S 7° 38′; d'A bright as I class: nucl: E. of Rosse spiral. Near star 7 m^s.)

Corona.—ζ, p. 282, *add* D 6 sometimes purpsh.—ν, p. 282, *add* Bu 15°·6: 104″·6, 1879.—η, p. 283, Hunt *comes* glimpsed 4 in. achr.—σ, p. 283, *last line, add to* 13, (Σ's scale.)—Σ **2029**, p. 284, *for* 187°·6 *read* 187°·5.

Crater.—p. 286. *Add*, from Sm, γ, XI^h 19^m, S 17° 1′: 4, 14: 102°·5: 3″; bright wh., grey. Sa 'most lovely:' *comes* 11 m^s.

Cygnus.—Σ **2671**, p. 291, *add* Se fixed; 'colori insigni,' yel., bl.; but sometimes changing.—Σ **2658**, p. 292, *add to* 10·2, (Moving.)—Σ **2479**, p. 292, *add* De divides 7·1: 20°·2: 0″·6; moving.—Σ **2639**, p. 293, *for* 5″·6 *read* 5″·5.—Σ **2538**, p. 293, *for* 52°·6 *read* 52°·5.—*Nova*, p. 295, *for* 42° 16′ *read* 42° 20′. The spectrum is said to be again becoming continuous.—p. 296, *add* Neb. (4514 (H IV 73). XIX^h 42^m, N 40° 13′. H plan. Star 11m^s. in centre. d'A resolved?)—p. 295, *add* Beautiful red var. 2° 51″·7 *n* of α, discovered by B, 1881, May 22.

Delphinus.—13, p. 298, *add* Duplicity discovered by Bu.—Triangle near β, p. 298, is Σ **2703** *infra.* (Moving.)—Σ **2664**, p. 298, *for* 322° 6 *read* 322°·5.

Draco.—*o*, p. 300, *for* 340°·8 *read* 340°·7.—Σ **1984**, p. 301, *for* 6″·6 *read* 6″·5.—Σ **2604**, p. 301, *for* 184°·6 *read* 184°·5.—Σ **2006**, p. 302, *for* 204°·6 *read* 204°·5.—Σ **2660**, p. 303, *for* 167°·6 *read* 167°·5.—η, p. 304, *add* Sm in field *n*, Σ **2054**: 5·7, 6·9: 7°·4: 0″·9: yelsh. (η is in Bedf. Cat. as wide pair, 3, 11: 31°: 190″.)

Eridanus.—Bu **316**, p. 308, *for* 8·1, 8·2, *read* 7·8, 7·8.—Σ **408**, p. 308, *add* (Moving.).

Gemini.—ζ, p. 310, *add* Bu 351°·6, 83°·5: 93″·7, 87″·2, 1880. (Sm 1831.)—OΣ **165**, p. 310, *for* (O, 45) *read* (F 45); *add* Bu thinks 10·7 only 12–13.—Σ **1108**, p. 310, *for* 11″·6 *read* 11″·5.—Σ **1124**, p. 312, *for* 325°·6 *read* 325°·5.—Σ **943**, p. 312, *for* 165°·9 *read* 155°·9.

Hercules.—p. 317, *add* Bu **627** (F 52). XVI^h 46^m, N 46° 12′: 5, 10: 309°·4: 1″·8.—Σ **33**[1] (P XVI 283, 285). XVI^h 58^m, N 13° 46′: 5·8, 6·3: 115°·4: 292″·5: wh., yel. (Σ 33, 34 Ophiuchi.)—OΣ **328**, p. 317, *add* K 10·2 very remarkable deep bl.—Σ **2056**, p. 319, H in Oph.—Σ **1993**, p. 320, *add* (Moving.)—Σ **2205**, p. 320, *should be* **2215**, in XVII^h 40^m.

Hydra.—R, p. 326, *add* Es splendid red.—Gould star 7 m^s. of 'superb crimson colour,' IX^h 46^m, S 22° 27′: (B 229).

Leo.—α, p. 328, *add* Sa 2^d *comes* easy, 12$\frac{1}{2}$ in. Calver spec.—90, p. 329, Se 7·5 twice bl., twice yel.—Vars., p. 332, Schwab finds 8 m^s., X^h 31^m, N 11° 27′, rapid var.—p. 333, Tempel discovered 1872 binuclear neb. ± XI^h 18^m, N 3° 59′, in thoroughly examined region, brighter and larger than ♅ II 32 near it.

Lepus.—p. 335, *add* Interesting field with two small pairs, 8–9^m *p* α. Mc Cance.—Crimson star, p. 335, *add* Heis 439[1].

Libra.—Bu **106**, p. 336, *add* Sa 12–13 easy, 10 in. Calver spec.—p. 336, *add* Bu **346**. XIV^h 42^m, S 16° 50′: De 7·2, 8: 235°·7: 1″·2.

Lyra.—ζ, p. 342, *add* Bu 2 very minute *comites*, 13, 11·8.—Σ **2458**, p 346, *add* [7·5 over-rated.]

Monoceros.—11. p. 348, *add* Bu's *comes* 13m^s. Σ.—p. 349, Σ **1157**, *add* (Moving.)—Σ **1077**, p. 351, *add* Cin triple.—p. 351, Vars, *add* U. VII^h 25^m, S 9° 32′: 6–7·2: ± 46^d. Gould, 1875.

Ophiuchus.—67, p. 352, *add* Bu quadruple.—p. 354, *add* Σ **2160** (Herc?) (P XVII 94). XVII^h 19^m, N 15° 43′: 61°·9: 4″·1: 5·5, 10: v. wh., ash. (In Bedford Cat.)—Σ **2184** (F 54). XVII^h 29^m, N 13° 15′: 76°·8: 21″·4: 6·3, 11·2: yel., o. (ditto.)—p. 355, Σ **2106**, *add* (Moving.) —*add* Bu **129** (P XVII 100). XVII^h 21^m, S 25° 25′: 7·5, 8: Cin 100°·3: 0″·9.

Orion.—β. p. 358. Bu sees *comes* round, 1880–81.—Σ **692**, p. 362, *add* Bu 7·8 double, De 7·9, 8·7: 355°·3: 0″·6. 1876.—Σ **609**, p. 363, *add* (Moving.).—Σ **735**, p. 363, *add* Rectilin: motion; widening.—Bu **188**, p. 364, *for* Hall *read* Holden.—**Red Star**, p. 364, *add* B 118. v^h 36^m, N 2° 18′: 7·8: Schjellerup decided red, 1863; Se yel. 1868; B bl., and Schjellerup no longer red, 1876.—p. 367, line 1, *for* 14¾ *read* 15.—Huggins & Salter agreed independently as to position of 6 minute stars in and close to trapezium.

Pegasus.—ϵ, p. 368, *add* Bu 325°·2, 321°·6: 81″·3, 140″·3.

Perseus.—p. 374, *add* Bu **535** (*o*, F 38). III^h 37^m, N 31° 54′: 4, 8·5: 60°·5: 1″.—OΣ **531**, p. 375, *add* Bu pair *sp*: 8, 11·5: 310°: 1″.—Σ **297**, p. 376, *add* Triple; 10·6: 106°·8: 28″·4.

Pisces.—p. 380, *add* Bu **5** (F 103). 1^h 33^m, N 16° 1′: 7, 9: 297°·3: 1″·3. (Moving?)—Bu **730** (F 27). XXIII^h 53^m, S 4° 13′: 5-6, 10: 265°·8: 1″·4.

Sagittarius.—μ^1, p. 383, *add* Jacob 312°·9, 115°·4: 48″·6, 50″·5, 1847. H a better measure of *comes* 262°·5.

Serpens.—p. 392, *add* [Bright open triangle, ± XVIII^h 0^m, S 3° 10′.]

Taurus.—Σ **430**, p. 396, *after* De and Bu *add* 37″·7.—ζ, p. 398. Chacornac's var. neb. 3½′ × 2½′, round star 11 mg. is 12·5 *s p*, 4′ 28″ *n* from this star.

Ursa Major.—Vars. p. 408, *add* H, η, (XIII^h 43^m, N 49° 55′) Es rapid?

Virgo.—p. 416, *add* (86. Double-double; as wide pair Σ **1780** rej. XIII^h 40^m, S 11° 49′: 5·5, 10·5: 298°·4: 1″·6; at 164°·7: 26″·9, pair 11·5, 13: 274°·2; 1″·7, Bu, very difficult.)—Bu **610**. XIII^h 18^m, S 20° 19′: 6·8, 10·5: 18°·3: 4″.—Bu **114**. XIII^h 28^m, S 8° 0′: 7·6, 8: De 137°·1: 1″·5.—Bu **116**. XIV^h 13^m, S 13° 9′: 7·7, 8·2: De 277°·4: 3″.

Vulpecula.—Σ **2692**, p. 419, *add* Triple: 12: 157°: est. 10″: from 9.

STARLESS FIELDS.

Several of these curious vacancies, through which we seem to gaze out into an uninterrupted infinity, have been mentioned by Herschel; but an extended list is to be found in the Cape Observations of his son, from which the following are selected as favourably situated for observation in northern latitudes. They are interesting not only from their peculiar aspect, but from the facility which they obviously afford for the detection of variable stars.

No.	R. Asc.	Dec.	Constell.	No.	R. Asc.	Dec.	Constell.
	h m	° ′			h m	° ′	
1	1 37	S 4 27	Cet.	18	XVI 33	S 24 0	Scorp.
2	1 48	S 10 38	...[a]	19	XVI 33	S 23 53	...
3	II 53	S 5 49	Erid.	20	XVI 40	S 21 4	Oph.
4	IX 37	N 17 16	Leo.	21	XVI 46	S 15 22	...
5	XVI 11	S 24 27	Scorp.[b]	22	XVII 15	S 26 45	...
6	XVI 13	S 21 24	...[c]	23	XVII 21	S 26 48	...
7	XVI 15	S 23 2	...[d]	24	XVII 22	S 26 40	...[i]
8	XVI 16	S 19 14	Oph.[e]	25	XVII 22	S 26 14	...
9	XVI 16	S 23 41	...[f]	26	XVII 26	S 8 47	...
10	XVI 17	S 23 10	...[g]	27	XVII 26	S 25 42	...
11	XVI 24	S 23 10	Scorp.	28	XVII 27	S 25 59	...
12	XVI 24	S 23 32	...	29	XVII 28	S 25 52	...
13	XVI 26	S 22 58	...	30	XVII 32	S 9 23	...[k]
14	XVI 26	S 24 31	...	31	XVII 56	S 4 47	Serp.
15	XVI 26	S 24 12	...	32	XVIII 10	S 7 44	...
16	XVI 29	S 24 21	...	33	XVIII 16	S 7 8	...
17	XVI 30	S 23 7	Oph.				

[a] Near ζ, $3^m f$, 18′ *n*. [b] Sa 6½ in. spec. minute stars. [c] Ditto. [d] Near ρ Oph, $3^m p$, 8′ *n*. [e] Near ψ, $1^m p$, 31′ *n*. [f] Near ρ, $3^m p$, 31′ *s* (see [b] and [c].) [g] To 24° 18′; $1'4^m p$ ρ. H 'not the smallest star. Sky perfectly pure and superb.' [h] To 23° 58′. [i] To 26° 56′. [k] Near μ, $30^s f$, 1° 20′ *s*. H with long attention one 17 ms. star.

APPENDIX II.

LIST OF DOUBLE STARS, RED STARS, CLUSTERS AND NEBULÆ, ETC., CONTAINED IN PART III. IN ORDER OF RIGHT ASCENSION, 1880.

THE following Index of Positions, for the entire revision, enlargement, and re-arrangement of which I am indebted (as well as for assistance in many similar matters) to the untiring care and accuracy of Mr. Franks, differs from that in the previous edition by the omission of the seconds of R.A., which were not only of little use to the student, but in some sense misleading, as giving an impression of minuter precision than has been attempted or would in many instances be attainable. The present list, it is hoped, will be always found sufficient for identification in a field of moderate dimensions: a greater amount of accuracy has been aimed at, but is not guaranteed; nor is it essential for the purpose of this little work. Where any discrepancy is noted between the position given in body of work and this index, the *latter* is to be taken as the more accurate. It may be as well to add that the inversions of nomenclature, which will occasionally be apparent, are the inevitable result of precession. Positions, to which the symbol ± is prefixed, must be looked upon as merely vague indications of the probable places.

(* *Star.*—N. *Nebula.*—C. *Cluster.*)

Hour 0.

m.		Declination.	Page
0	Σ 3060 Peg.	N 17° 23′	371
0	Σ 3061 Peg.	N 17° 10′	371
3	β Cass.	N 58° 29′	268
4	22 And.	N 45° 24′	215
7	OΣ 2 And.	N 26° 19′	216
7	B 2 Pisc.	N 0° 28′	381
9	35 Pisc.	N 8° 9′	378
10	Σ 16 Cass.	N 53° 57′	267
10	Σ 17 And.	N 28° 37′	217
11	Σ 20 Peg.	N 15° 50′	371
11	38 Pisc.	N 8° 12′	379
12	Σ 24 And.	N 25° 28′	216
13	Σ 25 Pisc.	N 15° 18′	381
14	B 4 And.	N 44° 3′	218
16	42 Pisc.	N 12° 49′	379
17	T Cass.	N 55° 8′	269
18	R And.	N 37° 55′	218
18	S Cet.	S 10° 0′	278
19	*Nova* (1572) Cass.	N 63° 24′	268
21	Σ 30 Cass.	N 49° 20′	267
24	Bu 394 Cass.	N 46° 52′	267
25	Σ 33 And.	N 33° 26′	217
26	Σ 34 Ceph.	N 77° 27′	274
26	κ Cass.	N 62° 16′	269

Hour 0.

m.		Declination.	Page
26	51 Pisc.	N 6° 18′	379
26	52 Pisc.	N 19° 38′	379
26	T Pisc.	N 13° 56′	381
28	P O 113 Cet.	S 5° 13′	276
29	Σ 40 And.	N 36° 10′	216
30	π And.	N 33° 4′	215
32	Σ 44 And.	N 40° 20′	217
34	Σ 47 And.	N 23° 23′	216
34	55 Pisc.	N 20° 47′	378
34	N 105. ♄ V 18 And.	N 41° 1′	219
34	α Cass.	N 55° 53′	265
35	Σ 48 Ceph.	N 70° 42′	272
35	P O 146 Cet.	S 5° 1′	276
36	N 116. M 31 And.	N 40° 35′	218
36	N 117. M 32 And.	N 40° 13′	219
37	C 120. ♄ VIII 78 Cass.	N 61° 8′	269
38	Σ 52 And.	N 45° 37′	217
38	Σ 55 And.	N 32° 58′	217
40	P O 175 And.	N 30° 19′	215
41	Σ 59 (P O 181) Cass.	N 50° 47′	267
41	Bu 494 Cet.	S 1° 54′	277
42	η Cass.	N 57° 11′	266
43	65 Pisc.	N 27° 4′	378
45	Σ 65 Cass.	N 68° 12′	267
46	Quintuple * Cass.	N 55° 59′	268
46	Σ 67 Peg.	N 9° 57′	371
48	OΣ 20 (66) Pisc.	N 18° 32′	380
48	Σ 72 And.	N 38° 32′	217
49	Σ 74 Pisc.	N 8° 46′	380
49	36 And.	N 22° 59′	215
49	γ Cass.	N 60° 4′	266
50	μ And.	N 37° 51′	214
52	U Ceph.	N 81° 14′	274
53	Σ 79 And.	N 44° 7′	210
53	P O 251 Pisc.	N 0° 8′	380
54	Σ 82 Pisc.	N 8° 52′	381
58	26 Cet.	N 0° 44′	276
59	ψ^1 Pisc.	N 20° 50′	378
59	Σ 86 Cet.	S 6° 5′	277
59	Σ 87 Pisc.	N 14° 45′	380

Hour I.

m.			
0	77 Pisc.	N 4° 16′	380
1	Σ 91 Cet.	S 2° 23′	277
3	N 218. ♄ II 224 And.	N 35° 4′	219
3	OΣ 23 Cass.	N 51° 6′	267

Hour I.

m.		Declination	Page
5	Bu 398 And.	N 47° 10′	217
5	Σ 96 (P O 312) Cass.	N 64° 24′	267
5	Σ 97 Cass.	N 50° 53′	268
6	Σ 98 Pisc.	N 31° 28′	380
7	φ Pisc.	N 23° 57′	379
8	ζ Pisc.	N 6° 56′	378
8	37 Cet.	S 8° 34′	276
10	Σ 106 Cet.	S 7° 46′	277
10	B 18 Pisc.	N 25° 8′	381
11	S Pisc.	N 8° 18′	381
11	S Cass.	N 71° 59′	269
12	Σ 110 Cet.	S 12° 57′	277
12	C 256. ♅ VII 42 Cass.	N 58° 9′	269
13	Σ 112 And.	N 45° 43′	217
14	42 Cet.	S 1° 8′	276
14	Bu 110 Cet.	S 16° 26′	277
15	Polaris	N 88° 40′	410
16·5	Group And.	N 38° 15′	219
17	ψ Cass.	N 67° 30′	266
19	N 307. ♅ I 151 Pisc.	N 8° 55′	381
20	ρ Pisc.	N 18° 33′	381
21	Σ 122 Pisc.	N 2° 55′	380
22	P I 85 Pisc.	N 7° 20′	379
24	Σ 129 Pisc.	N 12° 2′	381
24	μ Pisc.	N 5° 31′	381
24	R Pisc.	N 2° 16′	381
25	C 341. M 103 Cass.	N 60° 2′	269
25	N 342. ♅ I 100 Cet.	S 7° 29′	278
26	Σ 130 Cass.	N 69° 18′	268
26	Σ 131 Cass.	N 60° 5′	267
27	N 351. ♅ II 4 Cet.	S 7° 38′	427
27	N 352. M 33 Tri.	N 30° 4′	402
29	100 Pisc.	N 11° 57′	379
29	Σ 137 Tri.	N 30° 43′	402
29	OΣ 33 Cass.	N 58° 1′	267
30	P I 123 Pisc.	N 7° 2′	379
32	Σ 140 And.	N 40° 29′	217
33	Σ 141 And.	N 38° 22′	217
33	Σ 142 Pisc.	N 14° 39′	380
33	Bu 5 (103) Pisc.	N 16° 1′	429
34	Σ 143 Tri.	N 33° 44′	402
35	Σ 146 Pisc.	N 9° 29′	381
35	N 385. M 76 Pers.	N 50° 59′	377
37	Σ 150 Cet.	S 7° 42′	277
38	Σ 148 Cass.	N 63° 13′	268
38	C 392. ♅ VI 31 Cass.	N 60° 38′	269

Hour I.

m.		Declination	Page
38	Σ 154 And.	N 43° 7′	217
38	Σ 155 Pisc.	N 8° 51′	380
40	Σ 158 Tri.	N 32° 34′	402
42	Σ 162 And.	N 47° 19′	216
43	Σ 163 Cass.	N 64° 16′	267
43	Σ 171 Cet.	S 2° 0′	277
44	1 (P I 179) Ari.	N 21° 41′	235
44	χ Cet.	S 11° 17′	278
44	Σ 175 Ari.	N 20° 31′	237
45	Σ 170 Ceph.	N 75° 40′	272
45	Σ 178 (P I 191) Ari.	N 10° 13′	236
46	Σ 179 And.	N 36° 44′	216
47	γ Ari.	N 18° 42′	234
47	Σ 3113 And.	N 44° 0′	217
47	B 31 Cass.	N 69° 37′	268
48	Σ 182 Cass.	N 60° 43′	267
49	56 And.	N 36° 40′	215
50	Σ 186 (P I 209) Pisc.	N 1° 15′	380
50	C 457. ♅ VII 32 And.	N 37° 5′	219
51	Σ 185 Ceph.	N 74° 56′	272
51	Σ 188 *rej.* Cass.	N 62° 20′	268
51	λ Ari.	N 23° 1′	235
52	58 Cet.	S 2° 39′	278
52	Bu 513 (48) Cass.	N 70° 19′	267
52	Σ 194 Ari.	N 24° 15′	236
53	Σ 195 And.	N 43° 54′	217
53	Σ 191 Cass.	N 73° 17′	267
53	P I 222 Ari.	N 20° 28′	236
54	Σ 197 Tri.	N 34° 43′	402
55	Σ 200 Ari.	N 23° 29′	237
56	Σ 199 Ceph.	N 67° 7′	273
56	ε Tri.	N 32° 42′	401
56	α Pisc.	N 2° 11′	378
56	H 647 Cet.	N 7° 6′	278
57	γ And.	N 41° 45′	214
57	10 Ari.	N 25° 22′	236
58	S Ari.	N 11° 57′	237
58	61 Cet.	S 0° 55′	276
59	Σ 212 Ari.	N 24° 30′	236

Hour II.

m.			
1	Σ 213 Pers.	N 50° 29′	376
3	Σ 218 Cet.	S 1° 1′	276
3	Σ 219 Tri.	N 32° 46′	402
3	14 Ari.	N 25° 22′	235
4	59 And.	N 38° 28′	215

Hour II.

m.		Declination	Page
4	♓ 224 Ari.	N 13° 7′	236
5	ι Tri.	N 29° 44′	401
6	♓ 228 And.	N 46° 56′	216
7	66 Cet.	S 2° 57′	276
8	♓ 232 Tri.	N 29° 50′	402
9	♓ 235 Pers.	N 55° 20′	376
9	♓ 237 Ari.	N 10° 14′	237
9	R Ari.	N 24° 30′	237
10	♓ 233 Ceph.	N 75° 50′	274
10	♓ 240 Ari.	N 23° 17′	236
10	P II 38 Tri.	N 28° 12′	402
11	♓ 244 Ari.	N 21° 38′	237
11	♓ 245 And.	N 39° 44′	216
11	♓ 246 Tri.	N 33° 53′	402
11	C 512, 521. ♅ VI 33, 34 Pers.	N 56° 36′	377
13	Group Pers.	N 54° 0′	377
13	ο (*Mira*) Cet.	S 3° 31′	275
13	♓ 249 Pers.	N 44° 3′	375
14	♓ 248 And.	N 42° 14′	217
14	B 41 Pers.	N 56° 35′	376
14	♓ 250 And.	N 36° 52′	217
14	♓ 251 And.	N 38° 50′	217
15	P II 61 And.	N 40° 51′	215
15	S Pers.	N 58° 2′	377
18	♓ 260 Pers.	N 53° 44′	376
18	♓ 261 Ari.	N 10° 58′	237
18	♓ 265 Cet.	S 2° 16′	277
19	♓ 266 Cet.	S 2° 39′	277
19	P II 72 Cass.	N 66° 52′	266
20	R Cet.	S 0° 43′	278
21	P II 89 Tri.	N 29° 22′	401
21	♓ 268 Pers.	N 55° 0′	375
25	C 553. h 227 Pers.	N 57° 0′	377
25	♓ 272 Pers.	N 57° 54′	376
25	♓ 273 Ari.	N 17° 50′	236
25	♓ 274 Cet.	N 0° 35′	277
26	♓ 276 Cet.	N 5° 47′	278
28	♓ 280 Cet.	S 6° 12′	277
30	ν Cet.	N 5° 3′	276
30	30 Ari.	N 24° 8′	235
31	♓ 282 Cam.	N 65° 8′	251
31	♓ 283 Cam.	N 60° 58′	251
31	♓ 285 Tri.	N 32° 54′	402
33	N 575. ♅ I 156 And.	N 38° 33′	219
34	♓ 291 Ari.	N 18° 17′	236
34	33 Ari.	N 26° 33′	236

Hour II.

m.		Declination	Page
35	C 584. M 34 Pers.	N 42° 17′	377
35	12 Pers.	N 39° 41′	374
35	Σ 295 (84) Cet.	S 1° 13′	277
35	0Σ 44 Pers.	N 42° 10′	376
37	N 600. M 77 Cet.	S 0° 31′	278
37	γ Cet.	N 2° 44′	275
37	P II 160 Tri.	N 28° 57′	401
37	Σ 297 Pers.	N 56° 2′	376
38	Σ 300 Ari.	N 28° 56′	236
39	Σ 301 Pers.	N 53° 25′	375
40	N 604. $\frac{H}{O}$ I 64 Erid.	S 8° 4′	309
41	Σ 305 Ari.	N 18° 52′	236
42	Σ 306 Cass.	N 59° 55′	267
42	η Pers.	N 55° 24′	374
42	T Ari.	N 17° 2′	237
43	π Ari.	N 16° 58′	235
43	Σ 313 Cet.	N 8° 26′	278
43	Σ 315 Erid.	S 11° 5′	308
44	Σ 314 Pers.	N 52° 30′	375
45	Σ 316 Pers.	N 36° 48′	376
46	20 Pers.	N 37° 51′	374
46	Σ 323 Cet.	N 5° 56′	277
47	B 51 Cam.	N 63° 50′	252
50	P II 191 Ceph.	N 78° 57′	271
51	Σ 330 Cet.	S 1° 3′	277
52	P II 220 Pers.	N 51° 53′	374
52	ε Ari.	N 20° 52′	235
52	Σ 332 Cet.	S 0° 4′	277
53	Σ 334 Cet.	N 6° 8′	277
54	Σ 336 Pers.	N 31° 57′	375
55	Σ 335 Cam.	N 63° 18′	251
55	Σ 338 Ari.	N 10° 21′	237
56	α Cet.	N 3° 37′	275
57	ρ Pers.	N 38° 23′	377
57	Bu 11 (ρ^2) Erid.	S 8° 10′	307
58	52 Ari.	N 24° 47′	236
58	Σ 342 Ari.	N 27° 27′	237

Hour III.

m.			
0	0Σ 50 Cass.	N 71° 5′	267
0	β Pers. (*Algol*)	N 40° 30′	373
1	Σ 349 Cam.	N 63° 21′	250
2	Bu 528 Cet.	S 4° 3′	277
3	Σ 6^1 Cet.	N 7° 3′	277
5	Σ 360 Pers.	N 36° 46′	375
5	0Σ 51 Pers.	N 43° 50′	376

Hour III.

m.		Declination	Page
6	Σ 364 Pers. . . .	N 38° 42′ . . .	376
7	Σ 362 Cam. . . .	N 59° 35′ . . .	250
7	94 Cet.	S 1° 39′ . . .	276
7	C 658. H VI 25 Pers. .	N 46° 47′ . . .	377
8	Σ 367 Cet. . . .	N 0° 19′ . . .	277
9	Σ 369 Pers. . . .	N 40° 2′ . . .	375
10	Σ 368 Cam. . . .	N 68° 3′ . . .	251
13	P III 28 Pers. . .	N 48° 39′ . . .	376
13	Σ 374 Cam. . . .	N 67° 2′ . . .	250
14	Σ 376 Ari. . . .	N 19° 19′ . . .	236
15	Σ 380 Taur. . . .	N 8° 20′ . .	398
17	Σ 383 Taur. . . .	N 17° 9′ . . .	397
19	Σ 384 Cam. . . .	N 59° 29′ . . .	250
19	Σ 385 Cam. . . .	N 59° 31′ . . .	249
19	Σ 386 Cam. . . .	N 54° 44′ . . .	251
20	OΣ 54 Cam. . . .	N 67° 10′ . . .	250
20	Σ 388 Pers. . . .	N 50° 2′ . . .	376
21	Σ 389 Cam. . . .	N 58° 57′ . . .	250
21	Σ 390 Cam. . . .	N 55° 2′ . . .	249
21	Σ 391 Pers. . . .	N 44° 39′ . . .	375
21	B 61 Pers. . . .	N 54° 58′ . . .	377
21	N 709. H I 60 Erid. .	S 21° 46′ . . .	309
21	Σ 394 Taur. . . .	N 20° 4′ . . .	396
22	R Pers.	N 35° 15′ . . .	377
24	Σ 396 Cam. . . .	N 58° 21′ . . .	250
24	Σ 401 Taur. . . .	N 27° 9′ . . .	396
24	Σ 403 Taur. . . .	N 19° 22′ . . .	398
24	Σ 406 Taur. . . .	N 4° 45′ . . .	396
24	Σ 71 Taur. . . .	N 27° 19′ . . .	396
25	Σ 400 Cam. . . .	N 59° 38′ . . .	250
25	Σ 408 Erid. . . .	S 4° 41′ . . .	308
27	7 Taur.	N 24° 4′ . . .	394
28	Σ 413 Pers. . . .	N 33° 17′ . . .	376
28	Σ 414 Taur. . . .	N 19° 25′ . . .	397
28	Σ 416 *rej.* Taur. . .	N 19° 24′ . . .	398
30	Σ 419 Ceph. . . .	N 69° 27′ . . .	272
31	P III 98 Erid. . . .	N 0° 12′ . . .	307
32	B 65 Cam. . . .	N 62° 15′ . . .	252
32	OΣ 59 Pers. . . .	N 45° 38′ . . .	375
33	Σ 425 Pers. . . .	N 33° 44′ . . .	375
33	P III 97 Cam. . . .	N 59° 35′ . . .	252
33	Σ 426 Pers. . . .	N 38° 44′ . . .	375
33	Σ 427 Taur. . . .	N 28° 23′ . . .	396
34	Σ 430 Taur. . . .	N 4° 45′ . . .	396
35	Σ 431 (*o*) Pers. . .	N 33° 35′ . . .	374
35	N 752. H I 107 Erid. .	S 18° 58′ . . .	309

Hour III.

m.		Declination	Page
35	Σ 436 Erid.	S 13° 2′	307
36	Σ 434 Pers.	N 38° 0′	375
37	Bu 535 (38) Pers.	N 31° 54′	429
37	Σ 439 Pers.	N 31° 48′	376
38	N 768 (*Pleiad.*) Taur.	N 23° 20′	399
39	Σ 443 Pers.	N 41° 7′	376
40	H VIII 80 Pers.	N 52° 18′	374
40	η (*Pleiad.*) Taur.	N 23° 44′	393
40	Σ 447 Pers.	N 37° 59′	376
41	Σ 445 Cam.	N 59° 45′	251
42	30 Taur.	N 10° 46′	395
43	OΣ 64 (P III 165) Taur.	N 23° 29′	397
43	Σ 457 Taur.	N 22° 18′	398
45	Σ 455 Cam.	N 69° 10′	251
47	ζ Pers.	N 31° 32′	373
47	OΣ 67 Cam.	N 60° 45′	249
48	32 Erid.	S 3° 19′	307
50	ε Pers.	N 39° 40′	373
53	Σ 476 Pers.	N 38° 18′	375
54	Σ 477 Pers.	N 41° 31′	376
54	λ Taur.	N 12° 9′	398
54	P III 213 Taur.	N 22° 52′	395
55	Σ 480 Cam.	N 55° 24′	251
55	Σ 487 Erid.	S 10° 49′	308
57	Σ 474 Cam.	N 75° 55′	251
57	N 801. H IV 53 Cam.	N 60° 31′	252
57	Σ 485 Cam.	N 62° 2′	249
57	Σ 489 Erid.	S 7° 22′	308
59	Σ 491 Taur.	N 10° 39′	397

Hour IV.

m.			
0	Σ 490 Cam.	N 59° 50′	251
0	OΣ 531 (P III 242) Pers.	N 37° 46′	375
0	Σ 493 Taur.	N 5° 22′	398
1	Σ 495 Taur.	N 14° 50′	396
2	Σ 494 Taur.	N 22° 47′	397
3	Σ 500 Pers.	N 39° 58′	376
6	C 820. H VII 61 Pers.	N 50° 54′	377
6	Σ 503 Cam.	N 63° 52′	251
7	Σ 512 Pers.	N 45° 7′	376
7	Σ 515 Taur.	N 2° 34′	398
9	39 Erid.	S 10° 33′	307
9	N 826. H IV 26 Erid.	S 13° 2′	308
10	o^2 (40) Erid.	S 7° 50′	307
13	Σ 522 Cam.	N 51° 20′	251
13	Σ 523 Taur.	N 23° 27′	397

Hour IV.

m.		Declination	Page
13	ϕ Taur.	N 27° 4′	394
15	χ Taur.	N 25° 21′	394
15	Σ 526 Cam.	N 59° 59′	251
15	Bu 87 (P IV 53) Taur.	N 20° 32′	397
15	T Taur.	N 19° 15′	398
15	U Taur.	N 19° 32′	399
16	Σ 536 Erid.	S 4° 58′	308
17	Σ 533 Pers.	N 33° 59′	374
17	62 Taur.	N 24° 1′	395
17	OΣ 81 (56) Pers.	N 33° 41′	375
17	Σ 535 Taur.	N 11° 5′	396
18	Σ 9[1] ($\kappa^1\kappa^2$) Taur.	N 22° 1′	395
19	Σ 544 Erid.	S 9° 1′	308
19	Bu 403 Erid.	S 2° 20′	308
20	Σ 545 Taur.	N 17° 56′	397
21	Σ 548 Taur.	N 30° 6′	396
22	R Taur.	N 9° 54′	398
22	θ^1 Taur.	N 15° 42′	394
23	1 Cam.	N 53° 39′	249
23	Σ 552 Pers.	N 39° 44′	375
23	80 Taur.	N 15° 23′	394
23	Bu 184 Erid.	S 21° 46′	307
23	S Taur.	N 9° 41′	398
24	Σ 553 Cam.	N 50° 49′	251
25	57 Pers.	N 42° 48′	374
26	Σ 557 Cam.	N 62° 44′	251
27	Σ 559 Taur.	N 17° 46′	396
28	58 Pers.	N 41° 1′	374
29	Aldebaran	N 16° 16′	393
29	88 Taur.	N 9° 55′	394
30	Σ 565 Pers.	N 41° 52′	375
30	2 Cam.	N 53° 15′	248
30	Σ 567 Taur.	N 19° 14′	398
30	Σ 569 Taur.	N 8° 57′	397
30	Σ 570 Erid.	S 10° 0′	307
31	Σ 572 Aur.	N 26° 41′	239
32	Σ 11[1] ($\sigma^2\sigma^1$) Taur.	N 15° 41′	396
32	Bu 88 (51) Erid.	S 2° 43′	307
33	Σ 576 Erid.	S 13° 16′	307
34	Σ 577 Aur.	N 37° 16′	240
35	τ Taur.	N 22° 44′	394
38	55 Erid.	S 9° 1′	307
38	Σ 589 Ori.	N 5° 5′	362
39	Σ 587 Cam.	N 52° 55′	250
39	B 83 Cam.	N 67° 57′	252
39	C 896. ♅ VIII 8 Taur.	N 18° 41′	400

Hour IV.

m.		Declination	Page
40	Bu 186 Erid.	S 7° 12′	308
44	π^2 Ori.	N 8° 42′	364
44	B 85 Taur.	N 28° 19′	398
45	Σ 603 Aur.	N 49° 24′	240
45	V Taur.	N 17° 20′	399
46	Σ 609 Ori.	N 1° 2′	363
47	Σ 604 Cam.	N 69° 54′	251
47	Bu 316 Erid.	S 5° 29′	308
48	7 Cam.	N 53° 33′	249
48	Σ 612 Ori.	N 7° 10′	362
49	Σ 614 Ori.	S 0° 43′	363
50	Σ 613 Aur.	N 43° 56′	240
50	62 Erid.	S 5° 22′	307
51	ω Aur.	N 37° 43′	238
52	P IV 257 Taur.	N 14° 22′	395
52	P IV 258 Ori.	N 1° 29′	360
52	R Ori.	N 7° 57′	364
52	Σ 617 Cam.	N 62° 51′	251
52	Σ 618 Cam.	N 62° 54′	250
52	Σ 619 Aur.	N 50° 6′	241
52	Σ 620 Ori.	N 13° 46′	363
52	Σ 621 Aur.	N 39° 2′	241
52	OΣ 92 (5) Aur.	N 39° 13′	238
52	Σ 623 Aur.	N 27° 10′	239
52	Σ 624 Erid.	S 5° 57′	308
52	H 2244 Cam.	N 69° 12′	252
53	β Cam.	N 60° 16′	252
53	ε Aur.	N 43° 39′	241
54	B 94 (R) Lep.	S 14° 59′	335
54	Σ 627 Ori.	N 3° 26′	361
54	Σ 12^1 Taur.	N 26° 31′	396
55	Σ 13^1 (11, 12) Cam.	N 58° 49′	249
56	P IV 278 Ori.	N 1° 26′	360
56	Σ 631 Lep.	S 13° 41′	335
57	C 977. H VII 21 Taur.	N 23° 36′	400
57	Σ 636 Erid.	S 8° 50′	308
59	B 96 Ori.	N 1° 1′	364

Hour V.

m.			
1	Σ 638 Cam.	N 69° 43′	250
1	OΣ 98 (14) Ori.	N 8° 20′	361
1	Σ 643 Ori.	N 8° 15′	363
2	Σ 644 Aur.	N 37° 9′	239
2	Σ 645 Aur.	N 27° 52′	239
3	P IV 269 Cam.	N 79° 5′	248
3	Σ 648 Aur.	N 31° 51′	240

Hour V.

m.		Declination	Page
3	Σ 649 Erid.	S 8° 49′	308
4	B 99 Erid.	S 5° 40′	308
5	Red * Lep.	S 12° 10′	335
5	Σ 652 Ori.	N 0° 53′	361
7	ι Lep.	S 12° 1′	334
7	ρ^1 Ori.	N 2° 43′	360
8	R Aur.	N 53° 27′	241
8	14 Aur.	N 32° 33′	237
8	Capella	N 45° 52′	237
8	κ Lep.	S 13° 5′	334
8	Σ 664 Ori.	N 8° 19′	362
9	Σ 657 Aur.	N 52° 43′	240
9	Σ 666 Aur.	N 33° 11′	240
9	Σ 667 Ori.	S 7° 14′	362
9	Rigel	S 8° 20′	358
10	P V 20 Taur.	N 18° 18′	395
10	Σ 669 Aur.	N 45° 7′	240
10	OΣ 103 (16) Aur.	N 33° 14′	238
10	Σ 671 Taur.	N 25° 58′	398
10	19 Aur.	N 33° 48′	242
11	λ (H V 22) Aur.	N 39° 59′	242
11	Σ 678 Ori.	N 4° 33′	363
12	C 1067. H VII 33 Aur.	N 39° 13′	242
12	P V 37 Taur.	N 20° 1′	395
12	Bu 188 (τ) Ori.	S 6° 58′	364
13	Σ 677 Cam.	N 63° 16′	250
14	Σ 686 Taur.	N 23° 55′	397
14	Σ 687 Aur.	N 33° 40′	241
14	Σ 688 Ori.	S 10° 52′	361
15	Σ 692 Ori.	S 8° 10′	362
15	Σ 693 Ori.	S 2° 8′	363
17	Σ 694 Taur.	N 24° 51′	397
17	23 Ori.	N 3° 26′	360
17	111 Taur.	N 17° 16′	395
17	P V 70 Lep.	S 24° 54′	334
17	Σ 697 Taur.	N 15° 55′	397
17	Σ 698 Aur.	N 34° 45′	239
17	Σ 699 Aur.	N 37° 56′	240
18	η Ori.	S 2° 31′	363
18	Σ 701 Ori.	S 8° 33′	361
19	N 1112. M 79 Lep.	S 24° 38′	335
19	Σ 706 Aur.	N 30° 14′	241
19	P V 84 Ori.	N 1° 49′	360
20	Σ 710 Ori.	S 11° 26′	363
20	C 1114. H VII 39 Aur.	N 35° 13′	426
20	Σ 712 Ori.	N 2° 49′	361

Hour V.

m.		Declination	Page
20·5	Quadruple * Ori.	N 3° 3′	364
21	ψ^2 Ori.	N 2° 59′	364
21	C 1119. M 38 Aur.	N 35° 47′	241
22	118 Taur.	N 25° 3′	395
23	H 702 Ori.	S 2° 3′	364
23	Σ 695 Cam.	N 79° 15′	251
23	Σ 718 Aur.	N 49° 17′	239
23	Bu 320 (β) Lep.	S 20° 51′	334
23	Σ 721 Ori.	N 3° 4′	361
23	S Ori.	S 4° 50′	364
23	Σ 725 (31) Ori.	S 1° 11′	360
24	Σ 726 Ori.	N 10° 10′	362
24	32 Ori.	N 5° 51′	359
24	N 1137. ♅ I 261 Aur.	N 34° 9′	242
25	33 Ori.	N 3° 12′	360
25	119 Taur.	N 18° 30′	398
25	Σ 730 Taur.	N 16° 59′	396
25	Σ 731 Ori.	S 2° 11′	363
26	δ Ori.	S 0° 23′	358
27	Σ 734 Ori.	S 1° 46′	361
27	Σ 735 Ori.	S 6° 35′	363
27	N 1157. M 1 Taur.	N 21° 56′	399
28	C 1166. M 36 Aur.	N 34° 4′	242
29	Σ 736 Aur.	N 41° 44′	239
29	Σ 737 Aur.	N 34° 2′	241
29	Σ 740 Taur.	N 21° 7′	397
29	λ Ori.	N 9° 51′	359
29	Σ 742 Taur.	N 21° 56′	397
29	Σ 743 Ori.	S 4° 30′	361
29	Σ 747 Ori.	S 6° 6′	360
29	N 1179. M 42 Ori.	S 5° 28′	365
30	C 1184. H 362 Ori.	S 4° 27′	364
30	ι Ori.	S 5° 59′	359
30	Σ 749 Taur.	N 26° 53′	397
30	Σ 750 Ori.	S 4° 27′	361
30	ζ Taur.	N 21° 4′	398
30·5	*** Ori.	N 0° 13′	364
31	26 Aur.	N 30° 25′	238
31	Σ 754 Ori.	S 6° 10′	361
32	Σ 755 Taur.	N 23° 13′	398
32	Σ 757 Ori.	S 0° 17′	362
33	σ Ori.	S 2° 40′	359
33	Σ 763 Ori.	N 10° 14′	363
34	Σ 764 Aur.	N 29° 27′	239
34	C 1220. H 3780 Lep.	S 17° 55′	335
34	Σ 766 Taur.	N 15° 18′	396

Hour V.

m.		Declination	Page
35	N 1225. H IV 34 Ori.	N 9° 2′	367
35	ζ Ori.	S 2° 0′	359
35	Group Taur.	N 23° 15′	400
36	N 1227. H V 28 Ori.	S 1° 55′	367
36	B 118 Ori.	N 2° 18′	429
36	Σ 776 Taur.	N 25° 18′	397
36	Σ 777 Taur.	N 22° 10′	398
37	Σ 778 Aur.	N 30° 52′	240
37	Σ 3115 Cam.	N 62° 45′	250
38	B 120 Taur.	N 24° 22′	398
39	B 121 Taur.	N 20° 38′	398
39	Σ 780 Cam.	N 65° 43′	250
39	Σ 785 Taur.	N 25° 53′	396
39	Σ 787 Taur.	N 21° 16′	397
40	γ Lep.	S 22° 29′	334
40	Σ 790 Ori.	S 4° 17′	362
41	N 1267. M 78 Ori.	S 0° 2′	367
41	Σ 792 Ori.	S 3° 17′	363
41	OΣ 118 (P V 222) Taur.	N 20° 49′	396
42	Σ 791 Aur.	N 39° 32′	241
42	52 Ori.	N 6° 25′	360
42	P V 225 Aur.	N 31° 45′	238
42	ζ Lep.	S 14° 51′	335
43	Σ 798 Ori.	S 8° 27′	362
44	Σ 799 Aur.	N 38° 31′	239
44	C 1295. M 37 Aur.	N 32° 32′	242
44	Σ 802 Aur.	N 40° 8′	240
44	Σ 805 Aur.	N 28° 25′	240
44	Σ 806 Taur.	N 17° 52′	398
45	Σ 808 Aur.	N 29° 44′	241
45	Σ 809 Ori.	S 1° 27′	362
47	Σ 813 Ori.	N 18° 54′	362
48	OΣ 123 Ori.	N 10° 14′	361
48	Σ 816 Ori.	N 5° 51′	361
48	Σ 817 Ori.	N 7° 0′	363
49	Σ 784 Cam.	N 84° 12′	251
49	Betelgeuze	N 7° 23′	357
49	Σ 820 Ori.	N 8° 58′	363
52	OΣ 125 Ori.	N 22° 29′	361
52	Σ 823 Ori.	S 7° 39′	363
52	OΣ 545 (θ) Aur.	N 37° 12′	238
53	Σ 826 Ori.	S 1° 19′	363
54	Σ 825 Aur.	N 36° 30′	240
54	35 Cam.	N 51° 34′	249
56	Σ 830 Gem.	N 27° 39′	312
56	3 Mon.	S 10° 36′	351

m.		Declination	Page
Hour V.			
57	Σ 834 Aur.	N 30° 15′	240
57	Σ 835 Ori.	N 18° 19′	362
58	Σ 831 Cam.	N 67° 58′	251
Hour VI.			
m.			
0	Σ 840 Ori.	N 10° 47′	363
1	C 1360. M 35 Gem.	N 24° 21′	313
2	C 1361. H VIII 24 Ori.	N 13° 59′	365
2	41 Aur.	N 48° 44′	238
2	OΣ 134 Gem.	N 24° 27′	311
2	Σ 853 Ori.	N 11° 41′	362
2	Σ 855 Ori.	N 2° 31′	361
3	4 Mon.	S 11° 8′	351
3	Σ 859 Ori.	N 5° 40′	362
3	B 135 Gem.	N 26° 2′	313
4	Σ 861 Aur.	N 30° 46′	240
5	Σ 867 Ori.	N 17° 26′	361
5	Σ 869 Mon.	S 9° 49′	349
5	B 136 Gem.	N 21° 54′	313
5	B 137 Gem.	N 22° 56′	313
7	Σ 866 Lyn.	N 62° 14′	340
7	Σ 872 Aur.	N 36° 12′	238
7	Σ 875 Lep.	S 13° 7′	335
8	Σ 877 Ori.	N 14° 37′	362
8	η Gem.	N 22° 32′	313
9	Σ 868 Cam.	N 73° 58′	251
9	Σ 880 Ori.	N 10° 37′	362
9	5 Mon.	S 6° 14′	351
9	Bu 323 Mon.	S 1° 41′	350
11	Σ 883 Aur.	N 39° 49′	241
11	4 Lyn.	N 59° 25′	338
12	Σ 884 Aur.	N 47° 9′	241
12	B 27 (Add.) Gem.	N 23° 19′	313
12	B 3 (Add. II) Can. Maj.	S 16° 46′	261
13	Σ 888 Aur.	N 28° 31′	240
14	Σ 895 *rej.* Ori.	N 5° 48′	363
15	Σ 897 Gem.	N 26° 43′	312
15	Σ 898 Mon.	N 11° 2′	350
16	Σ 899 Gem.	N 17° 38′	311
16	Σ 896 Aur.	N 51° 55′	241
16	μ Gem.	N 22° 34′	310
18	Σ 901 Mon.	N 10° 35′	349
18	8 Mon.	N 4° 39′	348
19	T Mon.	N 7° 9′	351
19	B 144 Gem.	N 14° 47′	312
21	Σ 906 Aur.	N 37° 29′	241

Hour VI.

m.		Declination	Page
21	15 Gem.	N 20° 52′	310
21	P VI 104 Mon.	N 0° 32′	349
21	Σ 914 Mon.	S 7° 25′	349
22	Σ 915 Mon.	N 5° 21′	350
22	C 1415 (10) Mon.	S 4° 41′	352
23	11 Mon.	S 6° 57′	348
24	Σ 918 Aur.	N 52° 33′	239
24	Σ 921 Mon.	N 11° 22′	349
25	C 1424. H VII 2 Mon.	N 4° 57′	351
25	20 Gem.	N 17° 52′	310
25	Σ 926 Mon.	N 5° 54′	349
27	Σ 928 Aur.	N 38° 38′	240
27	Σ 929 Aur.	N 37° 48′	239
27	Σ 932 Gem.	N 14° 51′	312
28	Σ 933 Aur.	N 41° 13′	240
28	B 148 Aur.	N 38° 32′	241
29	Σ 935 Lyn.	N 52° 23′	340
29	Σ 936 Lyn.	N 58° 12′	339
29	Σ 939 Mon.	N 5° 25′	350
29	Σ 940 Aur.	N 38° 33′	241
30	Σ 941 Aur.	N 41° 41′	239
30	Σ 942 Gem.	N 23° 47′	312
30	Σ 943 Gem.	N 23° 17′	312
31	γ Gem.	N 16° 30′	310
31	ν^1 Can. Maj.	S 18° 34′	260
32	Σ 945 Aur	N 41° 6′	239
32	O Σ 152 (54) Aur.	N 28° 22′	238
32	R Mon.	N 8° 52′	351
33·5	Red * (Ll 12758) Can. Maj.	S 12° 55′	427
34	Σ 949 Mon.	N 5° 50′	350
34	P VI 174 Lyn.	N 59° 34′	338
34	15 Mon.	N 10° 0′	348
34	S (15) Mon.	N 10° 0′	351
34	Σ 952 Mon.	N 10° 3′	350
34	Σ 953 Mon.	N 9° 7′	349
35	Σ 3118 Mon.	N 9° 55′	350
36	12 Lyn.	N 59° 34′	338
37	ε Gem.	N 25° 15′	309
37	Ll 12936 Can. Maj.	S 15° 54′	261
38	Σ 957 Gem.	N 31° 0′	311
38	56 Aur.	N 43° 42′	238
38	Σ 958 Lyn.	N 55° 52′	339
39	Group Gem.	N 13° 2′	312
40	P VI 215 Lyn.	N 53° 9′	339
40	Sirius	S 16° 33′	259
41	Σ 962 Gem.	N 26° 52′	312

Hour VI. m.		Declination	Page
42	Σ 964 Aur.	N 43° 54′	241
42	C 1454. M 41 Can. Maj.	S 20° 37′	261
42	Σ 970 Can. Maj.	S 11° 36′	260
43	Σ 971 Can. Maj.	S 13° 19′	260
43	Σ 968 Lyn.	N 52° 48′	340
43	14 Lyn.	N 59° 35′	338
44	Σ 976 Gem.	N 18° 50′	311
46	C 1465. H VI 27 Mon.	N 0° 36′	351
48	Σ 973 Cam.	N 75° 24′	250
48	Σ 979 Aur.	N 46° 42′	240
48	Σ 981 Gem.	N 30° 23′	311
48	38 Gem.	N 13° 20′	310
48	Σ 986 Mon.	N 9° 41′	350
48	Σ 987 Mon.	S 5° 41′	349
49	Σ 990 Can. Maj.	S 14° 6′	260
50	Σ 991 Gem.	N 25° 9′	311
50	Bu 326 Ori.	N 2° 28′	362
51	Σ 994 Aur.	N 37° 16′	239
51	μ Can. Maj.	S 13° 53′	260
51	Σ 998 Mon.	S 5° 21′	350
51	R Lyn.	N 55° 31′	341
52	Bu 327 Mon.	S 2° 52′	350
52	Group Gem.	N 14° 25′	312
52	Σ 1000 Gem.	N 25° 25′	311
53	Σ 1003 Mon.	S 9° 0′	350
54	Σ 1001 Lyn.	N 54° 23′	339
54	Σ 1002 Lyn.	N 56° 37′	340
55	Σ 1010 Mon.	S 2° 55′	349
55	Σ 1011 Can. Maj.	S 15° 9′	260
56	P VI 301 Lyn.	N 52° 56′	338
56	Σ 1006 Cam.	N 62° 46′	250
57	ζ Gem.	N 20° 45′	310
57	C 1483. M 50 Mon.	S 8° 10′	351
57	σ (22) Can. Maj.	S 27° 46′	427
58	Σ 1012 Aur.	N 28° 20′	241
59	Σ 1014 Gem.	N 26° 21′	312
59	Σ 1015 Mon.	S 5° 35′	350
Hour VII. m.			
0	R Gem.	N 22° 53′	313
0	Σ 1017 Gem.	N 17° 2′	312
1	B 165 Mon.	S 7° 23′	351
1	Σ 1023 Gem.	N 25° 13′	311
1	OΣ 165 (45) Gem.	N 16° 8′	310
2	B 166 Can. Maj.	S 11° 44′	261
2	R Can. Min.	N 10° 14′	263

Hour VII.

m.		Declination	Page
2	Σ 1027 Gem.	N 17° 7′	311
2	Σ 1029 Mon.	S 4° 27′	349
3	Σ 1030 Mon.	S 8° 31′	350
3	Σ 1031 Can. Maj.	S 13° 47′	260
3	Σ 1025 Lyn.	N 56° 0′	339
4	Σ 1034 Mon.	S 8° 7′	350
4	Σ 1035 Gem.	N 22° 29′	311
5	Σ 1033 Lyn.	N 52° 47′	339
5	Σ 1037 Gem.	N 27° 28′	311
7	Σ 1043 Mon.	S 0° 28′	350
7	Σ 1045 Mon.	S 2° 58′	349
8	Σ 1044 Lyn.	N 47° 53′	340
9	Σ 1052 Mon.	S 10° 5′	350
9	Σ 1056 Mon.	S 1° 39′	349
10	Σ 1054 Gem.	N 35° 9′	311
10	Σ 1050 Lyn.	N 55° 9′	339
11	OΣ 170 (P VII 52) Can. Min.	N 9° 31′	262
11	λ Gem.	N 16° 45′	310
12	C 1512. ♅ VII 12 Can. Maj.	S 15° 25′	261
12	Σ 1069 Can. Maj.	S 13° 31′	260
13	Σ 1067 Can. Min.	N 3° 6′	262
13	Σ 1068 Gem.	N 13° 36′	312
13	19 Lyn.	N 55° 30′	338
13	20 Lyn.	N 50° 22′	338
13	δ Gem.	N 22° 12′	310
14	Σ 1070 Gem.	N 34° 16′	312
14	30 Can. Maj.	S 24° 44′	260
15	Σ 1076 Can. Min.	N 4° 17′	263
15	Σ 1077 Mon.	S 0° 28′	351
17	Σ 1081 Gem.	N 21° 41′	311
17	Σ 1082 Can. Min.	N 10° 56′	262
18	Σ 1083 Gem.	N 20° 44′	311
19	Σ 1088 Gem.	N 14° 22′	311
20	Σ 1086 Lyn.	N 43° 0′	339
20	Σ 1089 Gem.	N 15° 5′	312
20	Σ 1090 Gem.	N 18° 47′	311
21	Σ 1094 Gem.	N 15° 34′	311
21	Σ 1095 Can. Min.	N 9° 0′	263
21	♅ V 66 Gem.	N 22° 24′	312
22	Bu 21 (η) Can. Min.	N 7° 11′	262
22	N 1532. ♅ IV 45 Gem.	N 21° 9′	314
22	P VII 116 Mon.	S 11° 19′	348
23	Σ 1099 Can. Min.	N 11° 48′	263
23	Σ 1101 Arg.	S 13° 35′	233
24	Σ 1103 Can. Min.	N 5° 30′	262
24	Σ 1104 Arg.	S 14° 45′	233

Hour VII.

m.		Declination	Page
25	Σ 1106 Gem.	N 16° 35′ . . .	312
25	U Mon.	S 9° 32′ . . .	428
26	Σ 1108 Gem.	N 23° 7′ . . .	310
26	Σ 1109 Mon.	S 0° 16′ . . .	350
26	Σ 1111 Mon.	S 8° 27′ . . .	350
26	S Can. Min.	N 8° 34′ . . .	263
27	T Can. Min.	N 12° 0′ . . .	263
27	Castor	N 32° 9′ . . .	309
27	B Suppl. H 3973 Arg. .	S 20° 41′ . . .	233
27	Σ 1114 Can. Min. . .	N 9° 35′ . . .	263
28	OΣ 174 Lyn.	N 43° 17′ . . .	339
28	Σ 1116 Can. Min. . .	N 12° 34′ . . .	262
28	B 6 (Add. II) Arg. . .	S 14° 16′ . . .	233
29	P VII 149 Arg. . .	S 23° 13′ . . .	232
31	C 1549. ♅ VI 1 Gem. .	N 21° 50′ . . .	314
31	Σ 1121 Arg.	S 14° 14′ . . .	233
31	C 1551. ♅ VIII 38 Arg. .	S 14° 12′ . . .	233
33	Procyon	N 5° 32′ . . .	261
34	Σ 1124 Gem.	N 22° 6′ . . .	312
34	P VII 159 Cam. . .	N 65° 27′ . . .	249
34	P VII 170 Can. Min. .	N 5° 30′ . . .	262
34	P VII 175 Arg. . .	S 26° 32′ . . .	232
34	Bu 201 Arg.	S 20° 0′ . . .	233
35	Σ 1129 Gem.	N 18° 20′ . . .	312
35	Σ 1130 Can. Min. . .	N 10° 0′ . . .	263
35	*Nova* Can. Min. . .	N 8° 40′ . . .	263
36	S Gem.	N 23° 44′ . . .	313
36	Σ 1127 Cam.	N 64° 21′ . . .	249
36	C 1564. M 46 Arg. . .	S 14° 32′ . . .	234
36	Σ 1132 Mon.	S 3° 15′ . . .	350
37	N 1567. ♅ IV 64 Arg. .	S 17° 55′ . . .	234
37	κ Gem.	N 24° 41′ . . .	310
39	C 1571. M 93 Arg. . .	S 23° 34′ . . .	234
40	2 Arg.	S 14° 24′ . . .	233
40	Σ 1137 Can. Min. . .	N 4° 26′ . . .	262
41	Σ 1140 Gem.	N 18° 38′ . . .	31[illegible]
41	Σ 1141 Mon.	N 0° 18′ . . .	350
42	5 Arg.	S 11° 54′ . . .	233
42	Σ 1143 Can. Min. . .	N 5° 47′ . . .	262
42	T Gem.	N 24° 2′ . . .	313
43	Σ 1147 Gem.	N 24° 49′ . . .	312
43	Σ 1149 Can. Min. . .	N 3° 33′ . . .	262
46	OΣ 182 Can. Min. . .	N 3° 41′ . . .	262
48	U Gem.	N 22° 19′ . . .	313
49	Σ 1157 Mon.	S 2° 28′ . . .	349
52	14 Can. Min.	N 2° 33′ . . .	262

Hour VII.

m.		Declination	Page
52	11 Arg.	S 22° 34′	233
53	Σ 1170 Canc.	N 14° 1′	254
54	C 1611. ♅ VI 37 Arg.	S 10° 27′	234
56	6 Canc.	N 28° 8′	255
56	OΣ 186 Canc.	N 26° 34′	254
56	Σ 1174 Lyn.	N 47° 37′	340
58	Σ 1169 Cam.	N 79° 51′	250
58	Σ 1177 Canc.	N 27° 52′	254
58	Σ 1178 Arg.	S 12° 52′	233
58	Σ 1179 Canc.	N 12° 25′	254
59	Σ 1181 Can. Min.	N 8° 35′	263
59	Σ 1182 Can. Min.	N 6° 12′	262

Hour VIII.

m.			
1	Σ 1183 Mon.	S 8° 54′	349
1	Σ 1184 Lyn.	N 38° 13′	340
2	Bu 334 Arg.	S 21° 42′	233
2	Σ 1187 Lyn.	N 32° 35′	339
2	Σ 1188 Canc.	N 30° 44′	254
3	29 Mon.	S 2° 38′	348
4	Σ 1191 Canc.	N 19° 25′	255
5	C 1630. ♅ VII 11 Arg.	S 12° 34′	234
5	ζ Canc.	N 18° 1′	253
5	Σ 1197 Canc.	N 29° 55′	254
5	Σ 1198 Hyd.	N 1° 38′	325
7	Σ 1193 Cam.	N 72° 46′	249
7	Σ 1200 Lyn.	N 50° 8′	340
8	C 1637. ♅ VI 22 Mon.	S 5° 26′	351
8	Σ 1204 Lyn.	N 38° 51′	340
9	Σ 1206 Canc.	N 7° 32′	255
10	R Canc.	N 12° 6′	255
10	Σ 1211 Lyn.	N 39° 21′	340
15	V Canc.	N 17° 40′	255
16	B.A.C. 2798 (OΣ²93) Lyn.	N 42° 24′	340
16	Σ 1219 Canc.	N 8° 1′	254
19	Σ 1222 Lyn.	N 37° 56′	340
20	ϕ^2 Canc.	N 27° 20′	253
20	v^1 Canc.	N 24° 56′	253
20	P VIII 72 Arg.	S 23° 39′	232
21	Σ 1225 Lyn.	N 51° 35′	340
21	Σ 1228 Canc.	N 27° 56′	254
22	P VIII 81 Mon.	S 2° 7′	349
23	Σ 1231 Canc.	N 31° 46′	254
24	Σ 1232 Urs. Maj.	N 66° 40′	407
24	Σ 1234 Lyn.	N 55° 45′	339
28	Σ 1242 Lyn.	N 47° 31′	340

Hour VIII.

m.		Declination	Page
29	P VIII 108 Hyd. . .	N 7° 2′ . . .	324
29	U Canc.	N 19° 18′ . . .	255
30	Σ 1246 Canc. . . .	N 10° 19′ . . .	254
32	Σ 1248 Urs. Maj. . .	N 62° 26′ . . .	407
32	Σ 1250 Urs. Maj. . .	N 52° 11′ . . .	408
33	Bu 208 Arg.	S 22° 16′ . . .	233
33	C 1681. M 44 Canc. . .	N 20° 22′ . . .	255
33	Σ 1255 Hyd.	N 6° 14′ . . .	325
34	Σ 1254 (P VIII 129) Canc.	N 20° 4′ . . .	254
34	Σ 1256 Lyn.	N 49° 44′ . . .	340
35	P VIII 131 Lyn. . .	N 49° 18′ . . .	339
35	Σ 1260 Hyd.	S 11° 44′ . . .	325
36	Σ 1264 Mon.	S 7° 58′ . . .	350
37	Σ 1263 Lyn.	N 42° 8′ . . .	340
37	S Canc.	N 19° 28′ . . .	255
38	31 (P VIII 152) Mon. .	S 6° 48′ . . .	351
39	Σ 1259 Lyn.	N 38° 54′ . . .	340
39	P VIII 160 Hyd. . .	S 2° 10′ . . .	324
39	ι Canc.	N 29° 12′ . . .	253
40	N 1691. Hj I 288 Cam. .	N 78° 40′ . . .	252
40	ε Hyd.	N 6° 51′ . . .	324
41	Σ 1274 Lyn.	N 38° 47′ . . .	339
41	Σ 1276 Canc.	N 11° 36′ . . .	254
41	Σ 1281 Hyd.	N 0° 29′ . . .	325
42	Σ 1275 Urs. Maj. . .	N 57° 58′ . . .	407
42	Σ 1279 Urs. Maj. . .	N 40° 1′ . . .	407
43	Σ 1282 Lyn.	N 35° 29′ . . .	339
43	Σ 1283 Canc.	N 15° 17′ . . .	254
44	Σ 1280 Urs. Maj. . .	N 71° 16′ . . .	407
45	C 1712. M 67 Canc. . .	N 12° 15′ . . .	255
45	N 1713. Hj I 200 Leon. Min.	N 33° 53′ . . .	334
46	Σ 1288 Canc.	N 28° 54′ . . .	255
47	Σ 1289 Lyn.	N 44° 2′ . . .	340
47	Σ 1292 Hyd.	S 0° 5′ . . .	326
47	S Hyd.	N 3° 31′ . . .	326
47	σ^2 Canc.	N 31° 2′ . . .	252
47	OΣ 195 (P VIII 200) Hyd.	N 8° 53′ . . .	325
48	Σ 3120 Lyn.	N 44° 7′ . . .	340
49	B 211 Canc.	N 17° 41′ . . .	255
50	T Hyd.	S 8° 41′ . . .	326
50	17 Hyd.	S 7° 31′ . . .	324
50	T Canc.	N 20° 19′ . . .	255
51	Σ 1293 Urs. Maj. . .	N 54° 26′ . . .	407
51	ι Urs. Maj.	N 48° 31′ . . .	404
51	64 Canc.	N 32° 55′ . . .	255
52	α Canc.	N 12° 19′ . . .	427

Hour VIII.

m.		Declination	Page
52	Σ 1296 Lyn.	N 35° 25′	340
53	Σ 1297 Canc.	N 23° 11′	254
54	66 Canc.	N 32° 43′	253
54	67 Canc.	N 28° 23′	255
55	Σ 1300 Canc.	N 15° 45′	255
55	Σ 1301 Canc.	N 26° 41′	255
55	Σ 1302 Hyd.	N 3° 13′	325

Hour IX.

m.			
0	Σ 1309 Hyd.	N 3° 17′	325
0	σ^2 Urs. Maj.	N 67° 37′	404
1	Σ 1311 Canc.	N 23° 28′	254
2	Σ 1312 Urs. Maj.	N 52° 52′	407
3	Σ 1304 Drac.	N 81° 54′	303
3	Σ 1315 Urs. Maj.	N 62° 9′	406
5	Σ 1318 Urs. Maj.	N 47° 28′	407
6	Bu 336 Hyd.	S 16° 19′	325
6	Σ 1321 Urs. Maj.	N 53° 13′	406
6	Σ 1322 Canc.	N 17° 0′	254
8	θ Hyd.	N 2° 47′	324
8	Σ 1327 Canc.	N 28° 25′	254
10	Σ 1329 Hyd.	S 0° 44′	325
10	Bu 212 Hyd.	S 7° 51′	325
10	Σ 1332 Leon.	N 24° 8′	330
11	Σ 1333 Lyn.	N 35° 52′	339
11	Σ 1331 Urs. Maj.	N 61° 51′	407
11	38 Lyn.	N 37° 19′	338
12	Σ 1326 Drac.	N 78° 57′	302
13	Σ 1338 Lyn.	N 38° 42′	339
14	N 1823. $\frac{H}{\delta}$ I 205 Urs. Maj.	N 51° 30′	409
14	39 Lyn.	N 50° 3′	338
14	α (40) Lyn.	N 34° 54′	340
14	Σ 1341 Urs. Maj.	N 51° 7′	408
14	Σ 1343 Hyd.	N 5° 31′	325
16	Σ 1344 Lyn.	N 39° 39′	340
17	21 Urs. Maj.	N 54° 32′	405
17	OΣ 200 Urs. Maj.	N 52° 6′	406
17	P IX 65 Hyd.	N 4° 0′	324
17	Bu 105 (κ) Leon.	N 26° 43′	330
18	Σ 1348 Hyd.	N 6° 50′	325
21	41 Lyn.	N 46° 8′	338
21	Σ 1349 Urs. Maj.	N 68° 2′	406
21	Σ 1353 Leon.	N 16° 16′	331
21	Σ 1355 Leon.	N 6° 49′	330
22	23 Urs. Maj.	N 63° 35′	404
23	τ^1 Hyd.	S 2° 15′	324

Hour IX.

m.		Declination	Page
23	Σ 1358 Urs. Maj.	N 45° 11′	406
24	Σ 1350 Urs. Maj.	N 67° 20′	406
24	Σ 1359 Urs. Maj.	N 56° 47′	408
24	Σ 1360 Leon.	N 11° 8′	330
25	NN 1861, 1863. H I 56, 57 Leon.	N 22° 2′	333
25	Bu 339 Hyd.	S 15° 13′	325
25	Σ 1364 Leon.	N 20° 32′	331
25	Σ 1365 Hyd.	N 2° 1′	325
26	6 Leon.	N 10° 15′	329
27	Σ 1362 Urs. Maj.	N 73° 37′	406
28	Σ 1369 Leon. Min.	N 40° 31′	333
29	Σ 1371 Sext.	N 4° 27′	392
34	Σ 1374 Leon. Min.	N 39° 30′	333
37	Σ 1376 Urs. Maj.	N 43° 46′	407
37	P IX 161 Sext.	N 3° 11′	392
38	R Leon. Min.	N 35° 4′	333
39	N 1909. H I 78 Urs. Maj.	N 72° 50′	410
41	R Leon.	N 11° 59′	332
42	16 Leon. Min.	N 40° 11′	333
43	Σ 1381 Urs. Maj.	N 61° 19′	408
46	Σ 1386 Urs. Maj.	N 69° 28′	409
46	Σ 1389 Leon.	N 27° 30′	331
46	NN 1949, 1950. M 81, 82 Urs. Maj.	N 69° 41′	408
46	B 229 Hyd.	S 22° 27′	428
48	9 Sext.	N 5° 30′	392
50	Σ 1399 Leon.	N 20° 19′	330
57	Σ 1402 Urs. Maj.	N 56° 4′	406
58	Σ 1404 Sext.	S 1° 6′	392
58	Ll 19662 Sext.	S 8° 59′	392
59	N 2008. H I 163 Sext.	S 7° 7′	392

Hour X.

m.			
0	Σ 1407 Urs. Maj.	N 65° 2′	408
1	Σ 1408 Urs. Maj.	N 73° 38′	408
2	Regulus	N 12° 33′	328
6	Σ 1413 Leon.	N 16° 57′	332
6	Σ 1416 Hyd.	S 15° 29′	325
7	N 2024. H I 79 Drac.	N 74° 0′	305
8	Σ 1415 Urs. Maj.	N 71° 40′	406
8	N 2041. H I 4 Sext.	N 4° 4′	393
9	Σ 1417 Leon.	N 19° 45′	331
10	Σ 18[1] (ζ) Leon.	N 24° 5′	330
11	Σ 1419 Leon.	N 10° 44′	331
11	Σ 1421 Leon. Min.	N 28° 8′	333

Hour X.

m.		Declination	Page
13	γ Leon.	N 20° 27′	328
15	Σ 1427 Urs. Maj.	N 44° 31′	406
18	Σ 1429 Leon.	N 25° 12′	331
18	P X 58 Urs. Maj.	N 53° 14′	405
19	N 2102. ♅ IV 27 Hyd.	S 18° 2′	326
19	P X 67 Leon.	N 9° 23′	329
21	N 2104. ♅ I 86 Leon. Min.	N 29° 7′	334
21	Σ 1434 Leon.	N 18° 41′	331
23	OΣ 220 (P X 85) Leon.	N 10° 45′	330
24	Σ 1439 Leon.	N 21° 24′	331
26	Σ 1442 Leon.	N 22° 40′	330
26	Σ 1443 Leon. Min.	N 38° 17′	333
27	Σ 1447 Leon.	N 23° 58′	330
28	Σ 1448 Leon.	N 22° 12′	330
28	Σ 1449 Leon. Min.	N 35° 45′	333
29	49 Leon.	N 9° 16′	329
30	Σ 1452 Sext.	N 3° 14′	392
31	Var * Leon.	N 11° 27′	428
33	Σ 1458 Leon. Min.	N 32° 19′	333
33	Σ 1459 Leon. Min.	N 39° 2′	333
33	Σ 1460 Urs. Maj.	N 42° 47′	407
36	Σ 1463 Urs. Maj.	N 47° 18′	408
36	Σ 1465 Urs. Maj.	N 45° 15′	408
36	Red * Urs. Maj.	N 68° 10′	408
36	R Urs. Maj.	N 69° 24′	408
37	35 Sext.	N 5° 23′	392
38	Σ 1468 Leon.	N 21° 22′	331
40	Σ 1470 Sext.	S 5° 5′	392
42	P X 159 Hyd.	S 15° 0′	324
42	NN 2203, 2207. ♅ I 17, 18 Leon.	N 13° 16′	332
42	Σ 1474 Hyd.	S 14° 38′	324
43	Σ 1471 Cam.	N 80° 26′	252
43	Σ 1476 Leon.	S 3° 24′	330
43	Σ 1477 Leon.	N 13° 34′	331
46	B 248 Hyd.	S 20° 37′	326
46	Σ 1482 (P X 179) Leon.	N 8° 7′	331
48	Σ 1483 Urs. Maj.	N 48° 8′	408
48	Σ 1486 Urs. Maj.	N 52° 45′	407
49	54 Leon.	N 25° 23′	329
50	Σ 1479 Cam.	N 83° 52′	251
52	Σ 1495 Urs. Maj.	N 59° 33′	406
54	Σ 1500 Leon.	S 2° 48′	331
55	R Crat.	S 17° 41′	286
56	Σ 1502 Leon.	N 15° 16′	331
56	α Urs. Maj.	N 62° 24′	405

Hour X.

m.		Declination	Page
58	Σ 1504 (P X 229) Leon. .	N 4° 16′ . . .	331
59	N 2301. ♅ I 13 Leon. .	N 0° 37′ . . .	333

Hour XI.

m.			
0	P X 239 Leon. . .	N 7° 41′ . . .	329
0	Σ 1509 Crat. . . .	S 12° 46′ . . .	286
1	Σ 1510 Urs. Maj. . .	N 53° 28′ . . .	406
2	Σ 1512 Urs. Maj. . .	N 63° 9′ . . .	407
4	N 2318. ♅ V 46 Urs. Maj.	N 56° 19′ . . .	409
5	S Leon.	N 6° 7′ . . .	332
7	P XI 9 Leon. . . .	N 20° 47′ . . .	329
8	Σ 1516 Drac. . . .	N 74° 7′ . . .	301
8	N 2343. M 97 Urs. Maj. .	N 55° 40′ . . .	409
9	Σ 1520 Urs. Maj. . .	N 53° 24′ . . .	406
9	N 2352. ♅ II 49 Leon. .	N 18° 46′ . . .	333
11	N 2360. ♅ I 270 Urs. Maj.	N 59° 26′ . . .	410
12	N 2362. ♅ I 271 Urs. Maj.	N 58° 39′ . . .	410
12	ξ Urs. Maj. . . .	N 32° 13′ . . .	404
12	ν Urs. Maj. . . .	N 33° 45′ . . .	404
13	Σ 1525 Urs. Maj. . .	N 48° 7′ . . .	408
13	Σ 1527 Leon. . . .	N 14° 56′ . . .	330
13	Σ 1529 Leon. . . .	S 1° 0′ . . .	330
14	P XI 39 Crat. . . .	S 6° 14′ . . .	286
14	NN 2377, 2373. M 66, 65 Leon. . . .	N 13° 39′ . . .	332
16	Σ 1533 Urs. Maj. . .	N 37° 44′ . . .	407
18	ι Leon.	N 11° 12′ . . .	329
18	Neb. Leon. . . .	N 3° 59′ . . .	428
18	Σ 1537 Leon. . . .	N 21° 17′ . . .	331
19	γ Crat.	S 17° 1′ . . .	427
19	Σ 3070 Leon. . . .	S 3° 44′ . . .	332
20	N 2413. ♅ I 194 Urs. Maj.	N 44° 15′ . . .	410
21	Σ 1539 Cam. . . .	N 81° 41′ . . .	251
21	83 Leon.	N 3° 40′ . . .	329
22	Σ 19[1] (τ) Leon. . .	N 3° 31′ . . .	330
23	57 Urs. Maj. . . .	N 40° 0′ . . .	405
24	Σ 1544 Urs. Maj. . .	N 60° 20′ . . .	406
25	P XI 91 Leon. . .	S 6° 3′ . . .	329
26	Σ 1548 Leon. . . .	S 2° 50′ . . .	331
26	17 Crat.	S 28° 36′ . . .	286
26	OΣ 235 Urs. Maj. . .	N 61° 46′ . . .	405
26	88 Leon.	N 15° 2′ . . .	329
28	90 Leon.	N 17° 28′ . . .	329
30	Σ 1553 Urs. Maj. . .	N 56° 48′ . . .	406
30	P XI 111 Urs. Maj. .	N 28° 27′ . . .	404
31	T Leon.	N 4° 1′ . . .	332

Hour XI.

m.		Declination	Page
32	Σ 1559 Urs. Maj. . .	N 64° 59′ . . .	406
32	P XI 126 Virg. . .	S 1° 46′ . . .	413
32	Σ 1561 Urs. Maj. . .	N 45° 46′ . . .	405
33	Σ 1564 Leon. . . .	N 27° 37′ . . .	331
33	Σ 1565 Leon. . . .	N 19° 41′ . . .	330
37	Σ 1568 Virg. . . .	N 1° 26′ . . .	416
39	Σ 1570 Urs. Maj. . .	N 46° 17′ . . .	407
42	Σ 7² (93) Leon. . .	N 20° 53′ . . .	330
43	β Leon.	N 15° 15′ . . .	328
43	Σ 1573 Drac. . . .	N 67° 58′ . . .	301
46	Σ 1575 Virg. . . .	N 9° 28′ . . .	414
46	Σ 1576 Urs. Maj. . .	N 31° 29′ . . .	407
47	N 2600. ♅ I 173 Urs. Maj.	N 37° 39′ . . .	409
48	γ Urs. Maj. . . .	N 54° 22′ . . .	408
49	Σ 1580 Virg. . . .	N 4° 14′ . . .	415
49	65 Urs. Maj. . . .	N 47° 9′ . . .	405
50	OΣ 241 Urs. Maj. . .	N 36° 7′ . . .	406
53	Σ 1583 Urs. Min. . .	N 87° 39′ . . .	411
53	N 2660. ♅ I 223 Urs. Maj.	N 51° 37′ . . .	410
55	Σ 1591 Virg. . . .	N 0° 19′ . . .	415
56	X Virg.	N 9° 45′ . . .	417
56	Σ 1588 Drac. . . .	N 73° 2′ . . .	303
57	Σ 1593 Virg. . . .	S 1° 47′ . . .	415
58	2 Com. Ber. . . .	N 22° 8′ . . .	280
58	R Com. Ber. . . .	N 19° 27′ . . .	281

Hour XII.

m.			
0	Σ 1600 Urs. Maj. . .	N 52° 36′ . . .	406
1	N 2723, ♅ I 195 Can. Ven.	N 43° 44′ . . .	259
1	Σ 1602 Drac. . . .	N 69° 46′ . . .	302
2	Σ 1603 Urs. Maj. . .	N 56° 8′ . . .	406
4	Σ 1604 Virg. . . .	S 11° 11′ . . .	414
4	Σ 1605 Virg. . . .	S 1° 31′ . . .	415
4	C 2752. ♅ I 19 Com. Ber.	N 19° 13′ . . .	282
5	Σ 1606 Can. Ven. . .	N 40° 33′ . . .	256
5	Σ 1607 Can. Ven. . .	N 36° 45′ . . .	257
5	Σ 1608 Urs. Maj. . .	N 54° 6′ . . .	407
7	Σ 1613 Can. Ven. . .	N 36° 27′ . . .	257
7	N 2786. M 98 Virg. . .	N 15° 34′ . . .	417
8	Σ 1615 Can. Ven. . .	N 33° 28′ . . .	256
8	T Virg.	S 5° 22′ . . .	416
9	Σ 1618 Virg. . . .	N 10° 41′ . . .	416
9	Σ 1619 Virg. . . .	S 6° 35′ . . .	415
10	2 Can. Ven. . . .	N 41° 20′ . . .	256
10	N 2806. ♅ I 35 Virg. .	N 13° 49′ . . .	417
11	Σ 1625 Cam. . . .	N 80° 47′ . . .	250

Hour XII.

m.		Declination	Page
12	N 2836. ♅ I 89 Com. Ber.	N 28° 50′	282
12	P XII 32 Virg.	S 3° 17′	413
13	N 2838. M 99 Virg.	N 15° 4′	418
13	N 2841. ♅ V 43 Urs. Maj.	N 47° 58′	409
13	Σ 1628 Virg.	N 12° 28′	416
13	Σ 1630 Urs. Maj.	N 57° 2′	408
13	R Corv.	S 18° 35′	285
14	N 2851. ♅ I 75 Com. Ber.	N 30° 17′	282
14	N 2855. ♅ I 90 Com. Ber.	N 29° 57′	282
15	Σ 1633 Com. Ber.	N 27° 42′	281
15	Σ 1635 Virg.	S 10° 46′	415
16	N 2878. M 61 Virg.	N 5° 8′	417
16	17 Virg.	N 5° 58′	413
16	12 Com. Ber.	N 26° 31′	280
18	Σ 1639 (68) Com. Ber.	N 26° 14′	281
18	N 2917. ♅ I 65 Corv.	S 18° 7′	285
19	N 2946. M 85 Com. Ber.	N 18° 52′	282
19	B 277 Virg.	N 1° 27′	416
20	N 2961. M 86 Virg.	N 13° 36′	418
20	Σ 1642 Can. Ven.	N 45° 25′	257
21	Σ 1643 Com. Ber.	N 27° 42′	281
21	N 2972. ♅ I 77 Can. Ven.	N 31° 53′	259
22	Σ 1645 Can. Ven.	N 45° 27′	257
22	N 3002. ♅ I 213 Can. Ven.	N 44° 45′	258
23	Σ 21[1] (17) Ccm. Ber.	N 26° 34′	281
24	N 3021. M 49 Virg.	N 8° 40′	417
24	N 3042. ♅ I 198 Can. Ven.	N 42° 18′	259
24	Bu 28 (P XII 104) Corv.	S 12° 43′	285
24	Σ 1647 Virg.	N 10° 23′	415
24	δ Corv.	S 15° 51′	285
25	Σ 1649 Virg.	S 10° 23′	414
25	N 3043. ♅ I 83 Com. Ber.	N 26° 26′	282
26	N 3049. M 88 Virg.	N 15° 5′	417
27	Σ 1652 Com. Ber.	N 21° 47′	281
27	Σ 1653 Can. Ven.	N 32° 41′	257
27	Σ 1654 Drac.	N 75° 28′	302
28	N 3075. ♅ I 31 Virg.	N 8° 21′	418
28	β Corv.	S 22° 44′	285
29	Σ 1659 Virg.	S 11° 21′	415
29	24 Com. Ber.	N 19° 2′	280
30	Σ 1661 Virg.	N 12° 4′	416
30	N 3101. ♅ I 92 Com. Ber.	N 28° 37′	282
30	N 3106. ♅ V 24 Com. Ber.	N 26° 39′	282
31	T Urs. Maj.	N 60° 9′	408
32	Σ 1664 Corv.	S 10° 50′	285
32	Σ 1665 Virg.	S 4° 40′	416

Hour XII.

m.		Declination	Page
32	R Virg.	N 7° 39′	416
34	N 3132. ♅ I 43 Virg. .	S 10° 57′	417
35	♎ 1668 Virg. . . .	N 9° 30′	415
35	♎ 1669 Corv. . . .	S 12° 21′	285
36	γ Virg.	S 0° 47′	412
36	N 3165. ♅ V 42 Can. Ven.	N 33° 12′	259
38	N 3182. M 60 Virg. . .	N 12° 13′	417
39	S Urs. Maj. . . .	N 61° 45′	408
39	B 290 Can. Ven. . .	N 46° 6′	257
39	♎ 1677 Virg. . . .	S 3° 12′	414
40	♎ 1678 Com. Ber. . .	N 15° 1′	281
41	♎ 1679 Can. Ven. . .	N 50° 28′	257
42	N 3227. ♅ I 39 Virg. .	S 5° 9′	418
43	N 3229. ♅ I 129 Virg. .	S 8° 1′	418
43	♎ 1681 Virg. . . .	N 4° 28′	416
45	P XII 196 Virg. . . .	S 9° 41′	413
45	N 3249. ♅ I 84 Com. Ber.	N 26° 9′	282
45	N 3258. M 94 Can. Ven. .	N 41° 47′	258
45	U Virg.	N 6° 12′	416
46	♎ 23[1] (32, 33) Com. Ber. .	N 17° 44′	281
46	P XII 202 Com. Ber. .	N 19° 50′	280
47	N 3278. ♅ II 75 Virg. .	N 11° 53′	418
47	35 Com. Ber. . . .	N 21° 54′	280
47	♎ 1686 Virg. . . .	N 15° 41′	415
48	P XII 232 Cam. . .	N 84° 4′	249
49	P XII 221 Virg. . .	N 12° 9′	414
50	♎ 1690 Virg. . . .	S 4° 11′	415
50	♎ 1691 Urs. Maj. . .	N 58° 49′	407
50	Cor Caroli . . .	N 38° 58′	256
51	♎ 1695 Urs. Maj. . .	N 54° 44′	406
51	O♎ 257 Can. Ven. . .	N 46° 15′	257
51	♎ 1698 Drac. . . .	N 75° 18′	303
51	N 3321. M 64 Com. Ber. .	N 22° 20′	281
52	♎ 1696 Com. Ber. . .	N 31° 2′	281
53	♎ 1699 Com. Ber. . .	N 28° 19′	281
53	♎ 1702 Can. Ven. . .	N 38° 55′	257
56	ε Virg.	N 11° 36′	412
57	Bu 341 Hyd. . . .	S 19° 56′	325
58	♎ 1712 Virg. . . .	N 10° 6′	416
59	♎ 1720 Cam. . . .	N 83° 35′	251

Hour XIII.

m.			
0	♎ 1718 Can. Ven. . .	N 51° 37′	257
1	♎ 1719 Virg. . . .	N 1° 10′	414
2	♎ 1722 Com. Ber. . .	N 16° 8′	281
4	♎ 24[1] (15, 17) Can. Ven. .	N 39° 8′	256

Hour XIII.

m.		Declination	Page
4	θ Virg.	S 4° 55′	413
5	N 3437. H I 96 Can. Ven.	N 37° 42′	259
6	OΣ 261 Can. Ven.	N 32° 44′	256
7	OΣ 262 Urs. Min.	N 74° 37′	411
7	54 Virg.	S 18° 11′	413
7	C 3453. M 53 Com. Ber.	N 18° 47′	281
9	Σ 25[1] Drac.	N 67° 55′	301
9	P XIII 25 Virg.	S 10° 43′	413
10	N 3474. M 63 Can. Ven.	N 42° 40′	258
12	OΣ 263 Can. Ven.	N 51° 13′	257
12	γ Hyd.	S 22° 32′	326
13	21 Can. Ven.	N 50° 19′	257
15	Σ 1734 Virg.	N 3° 34′	414
17	Σ 1738 Virg.	S 14° 18′	415
18	Σ 1740 Virg.	N 3° 20′	414
18	Σ 1742 Virg.	N 2° 0′	415
18	Bu 610 Virg.	S 20° 19′	429
19	ζ Urs. Maj.	N 55° 33′	403
20	W Virg.	S 2° 45′	417
22	V Virg.	S 2° 33′	417
23	OΣ[2] 123 Drac.	N 65° 22′	304
23	OΣ 266 Com. Ber.	N 16° 20′	281
23	R (P XIII 94) Hyd.	S 22° 40′	326
25	N 3572. M 51 Can. Ven.	N 47° 49′	258
27	S Virg.	S 6° 35′	416
27	Σ 1755 Can. Ven.	N 37° 24′	257
28	Σ 1756 Com. Ber.	N 23° 37′	281
28	Bu 114 Virg.	S 8° 0′	429
28	P XIII 127 Virg.	N 0° 18′	414
28	Z Virg.	S 12° 36′	417
28	Σ 1758 Can. Ven.	N 49° 45′	257
29	Σ 1760 Com. Ber.	N 26° 53′	281
29	Σ 1761 Urs. Min.	N 72° 20′	411
31	81 Virg.	S 7° 16′	413
31	Σ 1767 Drac.	N 68° 22′	303
32	Σ 1764 Virg.	N 3° 0′	414
32	Σ 1768 (25) Can. Ven.	N 36° 54′	256
33	P XIII 156 Urs. Maj.	N 51° 20′	405
33	Σ 1771 Urs. Min.	N 70° 23′	411
35	1 Boöt.	N 20° 34′	245
35	Σ 1773 Virg.	N 8° 13′	416
36	83 Urs. Maj.	N 55° 17′	408
37	C 3636. M 3 Can. Ven.	N 28° 58′	258
37	o (84) Virg.	N 4° 9′	413
37	Σ 1776 Can. Ven.	N 46° 48′	257
37	P XIII 171 Virg.	S 3° 40′	414

Hour XIII.

m.		Declination	Page
40	Σ 1781 Virg.	N 5° 43′	415
40	86 Virg.	S 11° 49′	429
41	OΣ 270 (τ) Boöt.	N 18° 3′	245
42	B 313 Hyd.	S 27° 46′	326
43	η Urs. Maj.	N 49° 55′	429
44	Σ 1785 Boöt.	N 27° 35′	246
45	P XIII 220 Boöt.	N 21° 52′	245
45	N 3671. ♅ I 256 Urs. Maj.	N 60° 48′	410
46	B. A. C. 4628 Can. Ven.	N 35° 15′	257
49	P XIII 238 Virg.	S 7° 28′	413
49	Σ 1789 Can. Ven.	N 33° 23′	257
50	Σ 1790 Virg.	S 4° 1′	416
54	Σ 1793 Boöt.	N 26° 23′	246
54	P XIII 277 Urs. Maj.	N 53° 41′	405
54	Σ 1794 Boöt.	N 20° 27′	247
55	Σ 1798 Urs. Min.	N 78° 59′	411
56	Σ 1797 Boöt.	N 20° 0′	247
56	τ Virg.	N 2° 7′	416
58	Σ 1799 Virg.	S 5° 57′	415

Hour XIV.

m.			
3	Σ 1804 Boöt.	N 21° 46′	247
4	Σ 1805 Virg.	N 4° 35′	416
5	Σ 1807 Virg.	S 2° 44′	415
5	Σ 1808 Boöt.	N 27° 11′	247
6	Σ 1810 Boöt.	N 28° 36′	247
7	Σ 1813 Boöt.	N 6° 0′	247
7	Σ 1814 Boöt.	N 50° 49′	247
8	T Boöt.	N 19° 38′	248
9	Σ 1816 Boöt.	N 29° 40′	246
9	Σ 1817 Boöt.	N 27° 17′	247
9	κ Boöt.	N 52° 21′	245
9	Σ 1819 Virg.	N 3° 41′	415
9	Σ 1820 Urs. Maj.	N 55° 53′	407
10	Arcturus	N 19° 49′	242
10	H 1249 Lib.	S 15° 53′	337
10	Σ 1827 Drac.	N 59° 47′	304
11	Σ 1825 Boöt.	N 20° 41′	246
11	Σ 1826 Boöt.	N 47° 33′	247
11	Σ 1828 Boöt.	N 24° 43′	248
11	Σ 1829 Boöt.	N 51° 1′	246
12	ι Boöt.	N 51° 55′	244
12	Σ 1831 Drac.	N 57° 16′	301
13	Bu 116 Virg.	S 13° 9′	429
16	P XIV 62 Lib.	S 7° 13′	336
16	Σ 1834 Boöt.	N 49° 3′	246

Hour XIV.

m.		Declination	Page
17	Σ 1839 Boöt.	N 54° 26′	247
18	P XIV 69 Boöt.	N 9° 0′	245
18	P XIV 70 Lib.	S 11° 7′	336
18	Σ 1838 Boöt.	N 11° 47′	246
19	S Boöt.	N 54° 21′	248
19	B 328 Boöt.	N 26° 15′	248
20	Σ 1843 Boöt.	N 48° 23′	246
20	Σ 1849 Urs. Min.	N 77° 13′	411
21	Σ 1842 Virg.	N 4° 14′	416
21	θ Boöt.	N 52° 24′	248
22	φ Virg.	S 1° 41′	413
23	N 3900. H I 70 Virg.	S 5° 26′	418
23	Σ 1850 Boöt.	N 28° 49′	245
25	Bu 117 Lib.	S 15° 5′	336
27	Σ 1855 Boöt.	N 32° 11′	247
27	R Cam.	N 84° 23′	252
29	Σ 1858 Boöt.	N 36° 5′	246
30	Σ 1860 Drac.	N 55° 46′	302
31	Σ 1861 Boöt.	N 12° 41′	248
32	R Boöt.	N 27° 16′	248
35	π Boöt.	N 16° 56′	244
35	ζ Boöt.	N 14° 15′	243
36	Σ 1867 Boöt.	N 31° 48′	246
36	Σ 1869 Virg.	S 5° 26′	415
37	Σ 1872 Drac.	N 58° 32′	301
38	Σ 1871 Boöt.	N 51° 55′	246
38	Σ 1874 Boöt.	N 49° 38′	246
39	54 Hyd.	S 24° 56′	324
39	Σ 1873 Boöt.	N 8° 13′	247
39	Σ 1875 Boöt.	N 38° 16′	248
40	Σ 1876 Lib.	S 6° 52′	337
40	ε Boöt.	N 27° 35′	243
41	Σ 1881 Virg.	N 1° 30′	414
41	Σ 1882 Drac.	N 61° 33′	302
42	Bu 346 Lib.	S 16° 50′	428
43	Σ 1883 Boöt.	N 6° 28′	246
43	Σ 1884 Boöt.	N 24° 52′	246
43	Bu 106 (μ) Lib.	S 13° 39′	336
44	α^2 Lib.	S 15° 33′	336
45	Σ 1886 Boöt.	N 10° 11′	246
46	39 Boöt.	N 49° 13′	244
46	ξ Boöt.	N 19° 36′	244
50	P XIV 212 Lib.	S 20° 52′	336
52	Bu 239 (59) Hyd.	S 27° 10′	325
53	Σ 1895 Boöt.	N 40° 39′	247
55	δ Lib.	S 8° 2′	337

Hour XIV.

m.		Declination	Page
55	P XIV 239 Lib.	S 2° 17′	337
56	N 4029. ♅ II 756 Boöt.	N 54° 23′	248
56	Σ 1905 Urs. Min.	N 71° 18′	411
58	Σ 1904 Virg.	N 5° 56′	414
59	Bu 119 Lib.	S 6° 33′	337

Hour XV.

m.			
0	Σ 1907 Boöt.	N 12° 4′	247
0	Σ 1908 Boöt.	N 34° 56′	247
0	44 Boöt.	N 48° 7′	244
0	N 4045. ♅ I 128 Virg.	N 2° 5′	418
2	P XIV 279 Boöt.	N 9° 41′	245
3	N 4058. ♅ I 215 Drac.	N 56° 14′	305
3	Σ 3090 Lib.	S 0° 31′	337
5	ι Lib.	S 19° 20′	337
5	Σ 1916 Boöt.	N 39° 28′	246
7	Σ 1917 Boöt.	N 15° 49′	248
7	Σ 1919 Boöt.	N 19° 44′	245
7	Σ 1920 Boöt.	N 47° 22′	247
7	Σ 1921 Boöt.	N 39° 5′	246
8	Σ 1923 Boöt.	N 14° 51′	247
8	P XV 14 Lib.	S 17° 59′	336
9	Σ 1928 Urs. Min.	N 72° 54′	411
10	Σ 1926 Boöt.	N 38° 43′	245
10	Σ 1927 Drac.	N 62° 17′	302
11	β Lib.	S 8° 56′	336
11	δ Boöt.	N 33° 46′	244
12	C 4083. M 5 Lib.	N 2° 32′	337
13	5 Serp.	N 2° 14′	389
13	Σ 1931 Serp.	N 19° 49′	390
13	Σ 1932 Cor.	N 27° 16′	284
13	Σ 1934 Boöt.	N 44° 16′	247
13	U Cor.	N 32° 5′	284
14	S Lib.	S 19° 57′	337
15	Bu 32 (6) Serp.	N 1° 9′	391
15	Σ 1935 Cor.	N 31° 9′	284
16	S Serp.	N 14° 45′	391
17	S Cor.	N 31° 48′	284
18	Σ 1936 Cor.	N 27° 31′	284
18	η Cor.	N 30° 43′	283
20	μ^1 Boöt.	N 37° 47′	244
21	P XV 76 Serp.	N 18° 36′	390
21	Σ 1939 Lib.	S 10° 29′	336
21	Σ 1941 Cor.	N 27° 3′	284
22	Σ 1943 Serp.	N 5° 46′	391
22	Σ 1944 Serp.	N 6° 30′	390

Hour XV.

m.		Declination	Page
22	Σ 1945 Serp.	N 15° 7′	391
23	Σ 1948 Drac.	N 55° 19′	303
24	Σ 3125 Urs. Min.	N 67° 29′	411
25	P XV 91 Lib.	S 19° 45′	336
25	Σ 1949 Serp.	N 13° 26′	391
25	Σ 1950 Cor.	N 25° 56′	284
26	Σ 1952 Serp.	N 10° 2′	390
29	δ Serp.	N 10° 56′	388
29	Σ 1956 Herc.	N 42° 15′	320
30	Σ 1961 Herc.	N 43° 57′	321
32	Bu 121 (B. A. C. 5163) Lib.	S 27° 16′	336
32	Σ 1962 Lib.	S 8° 24′	336
33	Σ 1963 Cor.	N 30° 30′	284
34	Σ 1964 Cor.	N 36° 37′	284
35	ζ Cor.	N 37° 2′	282
35	P XV 153 Boöt.	N 47° 12′	248
36	Bu 35 (P XV 150) Lib.	S 15° 37′	336
36	Σ 1966 Lib.	S 10° 45′	337
36	π^1 Urs. Min.	N 80° 51′	411
38	α Serp.	N 6° 48′	388
39	Σ 1969 Drac.	N 60° 24′	303
40	Σ 1980 Urs. Min.	N 81° 29′	411
41	β Serp.	N 15° 48′	389
41	Σ 3096 Lib.	S 4° 56′	337
42	Σ 1973 Cor.	N 36° 51′	284
42	Σ 1976 Drac.	N 59° 51′	303
44	Σ 3097 Lib.	S 8° 40′	337
44	Σ 3126 Serp.	S 2° 47′	391
44	R Cor.	N 28° 32′	284
45	R Serp.	N 15° 30′	391
45	Σ 1978 Serp.	N 15° 1′	391
46	Σ 1979 Serp.	N 22° 50′	391
46	2 Scorp.	S 24° 58′	387
47	R Lib.	S 15° 52′	337
48	Σ 1984 Drac.	N 53° 15′	301
50	Σ 1985 Serp.	S 1° 48′	390
50	Σ 1986 Serp.	N 10° 25′	391
51	P XV 220 Serp.	N 3° 45′	390
51	Σ 1988 Serp.	N 12° 50′	390
53	Σ 3101 Serp.	S 2° 43′	391
54	Σ 1990 Serp.	N 22° 8′	390
54	T Cor.	N 26° 16′	284
54	Σ 1996 Drac.	N 57° 36′	304
55	OΣ 303 Serp.	N 13° 37′	390
55	Σ 1993 Herc.	N 17° 44′	320
58	Σ 2000 Herc.	N 14° 18′	320

Hour XV. m.		Declination	Page
58	ξ Scorp. (51 Lib.)	S 11° 2′	387
58	β Scorp.	S 19° 29′	386
58	Σ 2006 Drac.	N 59° 16′	302
Hour XVI. m.			
1	Σ 2007 Herc.	N 13° 39′	318
1	Σ 2008 Serp.	S 2° 17′	391
1	R Herc.	N 18° 43′	321
1	11 Scorp.	S 12° 25′	387
3	κ^1 Herc.	N 17° 22′	316
4	Σ 2034 Urs. Min.	N 83° 58′	411
5	ν Scorp.	S 19° 9′	386
5	Σ 2015 Herc.	N 45° 42′	319
7	Σ 2017 Serp.	N 14° 49′	390
8	49 Serp.	N 13° 51′	390
9	Σ 2023 Herc.	N 5° 49′	319
9	Σ 2027 Herc.	N 4° 35′	320
9	Σ 2029 Cor.	N 29° 2′	284
10	N 4173. M 80 Scorp.	S 22° 42′	388
10	σ Cor.	N 34° 10′	283
10	T Scorp.	S 22° 41′	388
11	R Scorp.	S 22° 39′	387
11	S Scorp.	S 22° 36′	387
12	Σ 2033 Oph.	S 1° 59′	356
13	P XVI 48 Scorp.	S 19° 50′	387
14	σ Scorp.	S 25° 18′	387
14	Σ 2037 Herc.	N 17° 41′	321
16	Σ 2041 Serp.	N 1° 26′	390
16	U Scorp.	S 17° 36′	388
16	N 4183. M 4 Scorp.	S 26° 14′	388
17	γ Herc.	N 19° 26′	315
18	ν^2 Cor.	N 33° 59′	282
18	ρ Oph.	S 23° 10′	353
18	23 Herc.	N 32° 37′	316
19	Σ 2045 Drac.	N 61° 48′	303
20	Σ 2044 Herc.	N 37° 21′	319
20	U Herc.	N 19° 10′	321
20	Σ 2047 Herc.	N 47° 54′	319
22	Σ 2048 (P XVI 88) Oph.	S 7° 52′	354
22	Antares	S 26° 10′	386
22	η Drac.	N 61° 47′	304
22	Σ 2054 Drac.	N 61° 58′	428
23	Σ 2049 Herc.	N 26° 14′	318
24	Σ 2051 Herc.	N 10° 50′	318
24	Σ 2052 Herc.	N 18° 41′	319
25	30 Herc.	N 42° 9′	321

Hour XVI.

m.		Declination	Page
25	Σ 2066 Urs. Min.	N 76° 34′	411
25	λ Oph.	N 2° 15′	352
26	Σ 2056 Herc.	N 5° 40′	319
26	Σ 2057 Herc.	N 19° 32′	321
26	Σ 2059 Herc.	N 38° 20′	320
26	Σ 2060 Drac.	N 56° 59′	304
26	C 4211. H VI 40 Oph.	S 12° 47′	357
27	S Oph.	S 16° 54′	356
27	T Oph.	S 15° 52′	356
28	Σ 2063 Herc.	N 45° 51′	317
29	Σ 2065 Herc.	N 40° 15′	319
29	OΣ 313 Herc.	N 40° 22′	318
30	V Herc.	N 37° 38′	321
30	P XVI 125 Herc.	N 17° 18′	321
31	33 Herc.	N 7° 21′	321
31	Σ 2068 Herc.	N 47° 30′	320
32	Group Herc.	N 31° 10′	323
33	Σ 2071 Herc.	N 13° 55′	321
33	17 Drac.	N 53° 10′	300
35	Σ 31[1] (36, 37) Herc.	N 4° 26′	317
35	Σ 2079 Herc.	N 23° 15′	318
35	42 Herc.	N 49° 10′	316
37	ζ Herc.	N 31° 49′	315
37	Σ 2083 Herc.	N 13° 50′	320
37	C 4230. M 13 Herc.	N 36° 41′	322
37	Σ 2085 Herc.	N 21° 48′	319
38	Σ 2087 Herc.	N 23° 51′	320
38	Σ 2091 Herc.	N 41° 25′	319
38	Σ 2092 Drac.	N 60° 56′	302
39	Σ 2094 Herc.	N 23° 42′	319
39	N 4234. Σ 5 N Herc.	N 24° 1′	323
40	46 Herc.	N 28° 35′	317
40	Σ 2097 Herc.	N 35° 57′	320
41	Σ 2098 Herc.	N 30° 11′	319
41	C 4238. M 12 Oph.	S 1° 45′	356
41	19 Oph.	N 2° 17′	354
41	Σ 2101 Herc.	N 35° 52′	317
44	N 4244. H IV 50 Herc.	N 47° 44′	323
44	Σ 2104 Herc.	N 36° 9′	317
45	OΣ 315 (21) Oph.	N 1° 25′	354
45	Σ 2106 Oph.	N 9° 36′	355
46	S Herc.	N 15° 9′	321
46	Bu 627 (52) Herc.	N 46° 12′	428
47	Σ 2107 Herc.	N 28° 51′	318
49	Σ 3106 Oph.	S 4° 59′	356
50	P XVI 236 Scorp.	S 19° 21′	387

Hour XVI.

m.		Declination	Page
50	56 Herc.	N 25° 56′ . . .	316
51	C 4256. M 10 Oph. . .	S 3° 56′ . . .	357
53	Σ 3107 Oph. . . .	N 4° 7′ . . .	355
53	*Nova* (1848) Oph. . .	S 12° 42′ . . .	356
54	Σ 2112 Herc. . . .	N 32° 0′ . . .	321
54	Σ 2116 Drac. . . .	N 63° 44′ . . .	303
54	C 4261. M 62 Scorp. .	S 29° 56′ . . .	388
54	Σ 32[1] Herc. . . .	N 47° 32′ . . .	318
55	C 4264. M 19 Oph. . .	S 26° 6′ . . .	357
56	P XVI 270 Oph. . .	N 8° 37′ . . .	354
58	Σ 2124 Drac. . . .	N 65° 24′ . . .	304
58	Σ 33[1] (P XVI 283, 285) Herc.	N 13° 46′ . . .	428

Hour XVII.

m.			
0	Σ 2119 Serp. . . .	S 13° 44′ . . .	390
0	Σ 2120 Herc. . . .	N 28° 15′ . . .	317
0	Σ 2122 Oph. . . .	S 1° 29′ . . .	354
1	Σ 2123 Oph. . . .	N 6° 59′ . . .	356
1	R Oph.	S 15° 56′ . . .	356
2	Σ 2128 Drac. . . .	N 59° 45′ . . .	303
3	μ Drac.	N 54° 38′ . . .	299
5	Bu 125 (P XVI 311) Oph.	S 26° 53′ . . .	355
5	Σ 2131 Herc. . . .	N 30° 30′ . . .	319
7	Σ 2132 Oph. . . .	S 3° 53′ . . .	355
7	Σ 2135 Herc. . . .	N 21° 23′ . . .	318
8	36 Oph.	S 26° 25′ . . .	352
8	Σ 2138 Drac. . . .	N 54° 40′ . . .	302
9	Σ 2137 Herc. . . .	N 16° 7′ . . .	320
9	α Herc.	N 14° 32′ . . .	315
10	31 Scorp.	S 26° 30′ . . .	387
10	δ Herc.	N 24° 59′ . . .	315
11	39 Oph.	S 24° 9′ . . .	353
11	π Herc.	N 36° 57′ . . .	321
13	C 4287. M 9 Oph. . .	S 18° 24′ . . .	357
13	C 4294. M 92 Herc. .	N 43° 16′ . . .	322
13	OΣ 328 (68) Herc. . .	N 33° 14′ . . .	317
14	ν Serp.	S 12° 43′ . . .	389
14	Σ 2149 Oph. . . .	S 6° 16′ . . .	356
14	Σ 2152 Herc. . . .	N 45° 42′ . . .	321
15	Σ 2153 Herc. . . .	N 49° 25′ . . .	321
18	Σ 2156 Oph. . . .	S 0° 42′ . . .	355
19	Σ 2159 Oph. . . .	N 13° 27′ . . .	355
19	Σ 2160 (P XVII 94) Oph.	N 15° 43′ . . .	428
20	ρ Herc.	N 37° 15′ . . .	315
20	Σ 2162 Herc. . . .	N 36° 37′ . . .	320
20	Σ 2164 Herc. . . .	N 47° 23′ . . .	319

Hour XVII.

m.		Declination	Page
21	Bu 129 (P XVII 100) Oph.	S 25° 25′	428
22	Σ 2165 Herc.	N 29° 33′	318
22	Σ 2166 Oph.	N 11° 31′	354
22	Σ 2168 Herc.	N 35° 51′	319
22	Σ 2179 Urs. Min.	N 72° 42′	411
23	B 410 Oph.	S 19° 22′	356
23	Σ 2170 Oph.	N 10° 35′	356
23	Σ 2171 Oph.	S 9° 54′	355
23	*Nova* (1604) Oph.	S 21° 16′	353
25	Σ 2178 Herc.	N 35° 4′	318
26	λ Herc.	N 26° 12′	316
26	P XVII 147 Drac.	N 50° 58′	300
27	Σ 2182 Herc.	N 23° 59′	320
29	53 Oph.	N 9° 40′	354
29	Σ 2184 (54) Oph.	N 13° 15′	428
30	ν^1 Drac.	N 55° 16′	300
30	Σ 2186 Oph.	N 1° 5′	355
30	Σ 2187 Oph.	N 4° 14′	355
30	Σ 2188 Oph.	N 6° 42′	356
31	C 4315. M 14 Oph.	S 3° 10′	357
31	Σ 2190 Herc.	N 21° 5′	317
33	Σ 2191 Oph.	S 4° 54′	355
36	P XVII 200 Herc.	N 24° 34′	317
36	Σ 2199 Drac.	N 55° 51′	302
37	Σ 2207 Drac.	N 67° 11′	303
38	B 418 Oph.	S 18° 36′	356
38	Σ 2200 Oph.	N 5° 54′	355
39	61 Oph.	N 2° 38′	354
40	Σ 2215 Herc.	N 17° 46′	320
40	X (3) Sagittar.	S 27° 47′	384
40	Σ 2204 Serp.	S 13° 14′	390
40	Σ 2211 Oph.	S 1° 9′	355
40	Σ 2212 Oph.	N 5° 44′	356
40	Σ 2213 Herc.	N 31° 11′	319
40	Σ 2214 Herc.	N 43° 47′	320
40	Σ 2218 Drac.	N 63° 44′	301
40	Σ 2219 Drac.	N 61° 40′	303
40	OΣ 340 Urs. Min.	N 86° 58′	411
41	OΣ 335 Herc.	N 21° 56′	319
42	Σ 2222 Oph.	N 14° 54′	355
42	μ Herc.	N 27° 48′	315
42	Σ 2225 Drac.	N 52° 0′	304
44	Σ 2227 Oph.	N 5° 22′	357
45	Σ 2232 Herc.	N 25° 18′	318
45	ψ^1 Drac.	N 72° 13′	300
47	Σ 2235 Oph.	S 2° 11′	355

Hour XVII.

m.		Declination	Page
47	Σ 2239 Herc.	N 28° 17′	320
48	Σ 2242 Herc.	N 44° 56′	319
49	Σ 2243 Herc.	N 36° 8′	320
50	C 4346. M 23 Oph.	S 19° 0′	356
51	Σ 2244 Oph.	N 0° 7′	355
51	P XVII 300 Herc.	N 18° 20′	317
51	Σ 2246 Herc.	N 39° 32′	320
52	Bu 417 Herc.	N 39° 27′	320
53	Σ 2250 Serp.	S 6° 51′	391
53	Σ 2252 Oph.	N 2° 2′	355
54	Σ 2254 Oph.	N 12° 29′	355
54	Σ 2258 Herc.	N 48° 39′	320
54	Σ 2259 Herc.	N 30° 3′	318
55	Σ 2247 Herc.	N 29° 28′	321
55	67 Oph.	N 2° 56′	352
55	OΣ² 164 Taur. P.	N 7° 45′	400
55	N 4355. H IV 41 Sagittar.	S 23° 2′	385
56	Σ 2261 Drac.	N 52° 14′	302
56	Σ 2263 Herc.	N 26° 34′	320
56	95 Herc.	N 21° 36′	316
57	N 4361. M 8 Sagittar.	S 24° 21′	385
57	τ Oph.	S 8° 11′	353
57	C 4367. M 21 Sagittar.	S 22° 31′	384
57	Group Sagittar.	S 18° 50′	385
57	W (γ^1) Sagittar.	S 29° 35′	384
58	Σ 2265 Oph.	N 6° 28′	355
58	Σ 2267 Herc.	N 40° 11′	319
58	Σ 2268 Herc.	N 25° 22′	319
58	Σ 2271 Drac.	N 52° 54′	302
59	Σ 2273 Drac.	N 64° 9′	301
59	N 4373. H IV 37 Drac.	N 66° 38′	304
59	70 Oph.	N 2° 32′	353
59	Group Herc.	N 26° 20′	323
59·5	Group Taur. P.	N 4° 32′	400

Hour XVIII.

m.			
0	P XVII 362 Taur. P.	N 12° 0′	400
0	Group Serp.	S 3° 10′	429
0	Σ 2277 Herc.	N 48° 29′	317
1	Σ 2278 Drac.	N 56° 26′	301
1	Σ 2279 Drac.	N 50° 53′	304
1	Σ 2284 Drac.	N 65° 57′	302
3	100 Herc.	N 26° 5′	317
3	101 Herc.	N 29° 2′	323
3	Σ 2282 Herc.	N 40° 22′	318
4	Σ 2283 Oph.	N 6° 8′	355

Hour XVIII.

m.		Declination	Page
4	73 Oph.	N 3° 58′	354
5	Group Herc.	N 23° 45′	323
5	T Herc.	N 31° 0′	321
5	♓ 2289 Herc.	N 16° 27′	317
6	C 4388. ♅ VII 30 Sagittar.	S 21° 36′	384
6	N 4390. ♓ 6 N Taur. P.	N 6° 50′	401
6	♓ 2291 Herc.	N 34° 0′	321
7	♓ 2292 Herc.	N 27° 37′	319
7	μ^1 Sagittar.	S 21° 5′	383
7	Group Oph.	N 4° 18′	357
8	♓ 2294 Serp.	N 0° 8′	390
9	40 Drac.	N 79° 59′	300
10	O♓ 346 Herc.	N 19° 43′	319
11	C 4397. M 24 Clyp.	S 18° 27′	279
11	♓ 2301 Herc.	N 23° 56′	321
12	♓ 2307 Drac.	N 69° 14′	303
12	C 4400. M 16 Clyp.	S 13° 50′	279
13	C 4401. M 18 Clyp.	S 17° 12′	279
14	N 4403. M 17 Clyp.	S 16° 15′	279
14	♓ 2303 Clyp.	S 8° 1′	279
15	♓ 2306 Clyp.	S 15° 9′	279
15	♓ 2309 Herc.	N 25° 28′	320
15	P XVIII 51 Herc.	N 29° 38′	321
17	♓ 2326 Ceph.	N 81° 27′	273
17	C 4406. M 28 Sagittar.	S 24° 56′	384
17	B 437 Herc.	N 25° 0′	321
18	♓ 2313 Clyp.	S 6° 40′	279
18	21 Sagittar.	S 20° 36′	383
20	Group Taur. P.	N 1° 40′	401
21	λ Sagittar.	S 25° 29′	383
21	59 Serp.	N 0° 7′	389
22	C 4410. ♅ VIII 72 Serp.	N 6° 29′	391
22	39 Drac.	N 58° 44′	300
23	T Serp.	N 6° 13′	391
23	♓ 2319 Herc.	N 19° 14′	318
23	♓ 2320 Herc.	N 24° 36′	318
24	V Sagittar.	S 18° 21′	384
25	♓ 2324 Serp.	N 1° 17′	391
25	♓ 2325 Clyp.	S 10° 52′	279
25	U Sagittar.	S 19° 13′	384
25	C. M 25 Sagittar.	S 19° 10′	384
25	♓ 2328 Lyr.	N 29° 53′	345
26	♓ 2329 Taur. P.	N 6° 23′	400
26	♓ 2330 Taur. P.	N 13° 6′	400
28	♓ 2337 Clyp.	S 14° 48′	279
28	♓ 2339 Herc.	N 17° 39′	318

Hour XVIII.

m.		Declination	Page
28	B 448 Lyr.	N 36° 54′	346
29	C 4424. M 22 Sagittar.	S 24° 0′	384
30	Σ 2342 Taur. P.	N 4° 50′	400
31	Σ 2346 Taur. P.	N 7° 26′	400
31	Σ 2348 Drac.	N 52° 15′	301
31	OΣ 358 Herc.	N 16° 53′	318
32	Σ 2347 Serp.	S 0° 31′	390
32	Σ 2349 Lyr.	N 33° 21′	344
32	Σ 2351 Lyr.	N 41° 13′	345
32	Group Serp.	N 5° 5′	392
32	Σ 2357 Drac.	N 63° 36′	303
33	Wega	N 38° 40′	341
34	Σ 2356 Lyr.	N 28° 36′	345
34	Σ 2358 Lyr.	N 30° 37′	346
34	P XVIII 151 Lyr.	N 35° 57′	344
34	Σ 2360 Herc.	N 20° 49′	319
35	Σ 2361 Serp.	N 3° 0′	391
36	Σ 2368 Drac.	N 52° 13′	302
36	Σ 2367 Lyr.	N 30° 11′	344
37	Σ 2371 Herc.	N 27° 33′	320
38	Σ 2369 Ant.	N 2° 29′	222
38	Σ 2372 Lyr.	N 34° 39′	344
38	OΣ 361 Taur. P.	N 5° 32′	400
39	Σ 2373 Clyp.	S 10° 37′	279
39	B 458 Lyr.	N 36° 51′	346
39	Σ 2376 Lyr.	N 30° 18′	345
39	C 4432. M 26 Clyp.	S 9° 31′	279
39	Σ 2380 Lyr.	N 44° 51′	344
40	Σ 2375 Taur. P.	N 5° 23′	400
40	5 Aquil.	S 1° 5′	228
40	ϵ^1 Lyr.	N 39° 33′	342
40	46 Drac.	N 55° 25′	304
40	T Aquil.	N 8° 37′	232
41	ζ Lyr.	N 37° 29′	342
41	R Clyp.	S 5° 50′	279
41	110 Herc.	N 20° 26′	316
41	111 Herc.	N 18° 3′	323
41	Σ 2390 Lyr.	N 34° 23′	344
41	Σ 2393 Lyr.	N 38° 13′	345
41	Σ 2394 Lyr.	N 41° 57′	346
42	Σ 2391 Clyp.	S 6° 8′	279
42	Σ 2397 Lyr.	N 31° 17′	344
43	Σ 2399 Aquil.	N 13° 7′	231
43	B 464 Aquil.	S 8° 2′	232
43	Σ 2403 Drac.	N 60° 56′	301
44	Σ 2401 Herc.	N 21° 1′	318

Hour XVIII.

m.		Declination	Page
44	C 4451. h 2024 Aquil.	N 10° 10′	232
44	⁂ Lyr.	N 28° 21′	347
45	C 4437. M 11 Ant.	S 6° 24′	222
45	Σ 2404 Taur. P.	N 10° 50′	400
45	P XVIII 226 Drac.	N 59° 11′	300
46	β Lyr.	N 33° 13′	342
46	C 4440. h 2020 Taur. P.	N 10° 12′	400
46	Σ 2408 Aquil.	N 10° 38′	230
47	N 4441. H I 47 Clyp.	S 8° 51′	280
47	Σ 2412 Aquil.	N 13° 52′	231
48	Bu 421 Lyr.	N 43° 15′	345
49	N 4447. M 57 Lyr.	N 32° 53′	347
49	o Drac.	N 59° 14′	300
50	Σ 2415 Herc.	N 20° 28′	318
50	δ Lyr.	N 36° 49′	346
50	θ^1 Serp.	N 4° 3′	389
50	B. A. C. 6468 Lyr.	N 33° 49′	346
51	Σ 2419 Lyr.	N 29° 6′	346
51	Group Lyr.	N 42° 0′	347
52	R Lyr.	N 43° 48′	346
52	B 475 Aquil.	N 14° 12′	232
53	Group Lyr.	N 38° 5′	347
54	Σ 2425 Ant.	S 8° 16′	222
54	Σ 2427 Lyr.	N 38° 6′	346
54	ε Aquil.	N 14° 54′	231
54	11 Aquil.	N 13° 28′	228
54	P XVIII 263 Aquil.	N 14° 45′	229
55	Σ 2430 Lyr.	N 29° 29′	345
56	Group Vulp.	N 27° 43′	420
56	Σ 2436 Aquil.	N 8° 35′	230
57	Σ 2437 Aquil.	N 19° 0′	231
57	P XVIII 274 Ant.	S 0° 53′	221
58	Σ 2439 Ant.	S 7° 21′	222
58	Σ 2441 Lyr.	N 31° 15′	345
58	Σ 2452 Drac.	N 75° 37′	301
58	B 483 Aquil.	S 5° 52′	232
59	Σ 2443 Aquil.	N 14° 37′	231
59	15 Aquil.	S 4° 13′	227
59	Σ 2448 Lyr.	N 35° 31′	345

Hour XIX.

m.			
0	P XVIII 302 Aquil.	N 6° 22′	229
0	Σ 2445 (1) Vulp.	N 23° 8′	419
0	Σ 2447 Aquil.	S 1° 31′	230
0	ζ Aquil.	N 13° 41′	231
0	Σ 2451 Drac.	N 51° 23′	304

Hour XIX.

m.		Declination	Page
1	Σ 2449 Aquil.	N 6° 57′	230
1	R Aquil.	N 8° 3′	232
2	Σ 2455 Vulp.	N 21° 58′	419
2	Σ 2456 Lyr.	N 38° 19′	345
2	Σ 2457 Ans.	N 22° 24′	220
2	Σ 2458 Lyr.	N 27° 35′	346
2	Σ 2459 Lyr.	N 25° 47′	345
3	17 Lyr.	N 32° 19′	343
3	Σ 2466 Lyr.	N 29° 38′	345
3	Σ 2467 Lyr.	N 30° 37′	346
3	Σ 2478 Drac.	N 69° 15′	304
4	Σ 2469 (P XIX 8) Lyr.	N 38° 43′	345
4	Σ 2470 Lyr.	N 34° 34′	344
4	P XIX 13 Lyr.	N 37° 43′	344
5	Σ 2474 Lyr.	N 34° 25′	344
6	Σ 2479 Cyg.	N 55° 7′	292
7	Σ 2481 Lyr.	N 38° 34′	345
8	Σ 2483 Lyr.	N 30° 9′	344
9	Σ 2484 Sagittæ	N 18° 52′	382
9	Σ 2486 Cyg.	N 49° 37′	291
9	T Sagittar.	S 17° 11′	384
10	R Sagittar.	S 19° 31′	384
10	67 (Bode) Aquil.	N 14° 52′	231
10	η Lyr.	N 38° 56′	343
11	Σ 2489 Aquil.	N 14° 20′	230
11	Σ 2491 Lyr.	N 28° 6′	345
11	OΣ 370 (P XIX 49) Aquil.	N 9° 7′	230
11	OΣ 371 Lyr.	N 27° 14′	344
12	S Sagittar.	S 19° 15′	384
12	Red * Sagittar.	S 16° 8′	384
12	C 4485. M 56 Lyr.	N 29° 58′	347
12	θ Lyr.	N 37° 55′	346
12	23 Aquil.	N 0° 52′	227
13	Σ 40[1] (24, P XIX 55) Aquil.	N 0° 10′	230
13	Bu 248 (2) Vulp.	N 22° 48′	419
13	N 4487. ♅ III 743 Aquil.	N 6° 20′	426
13	Σ 2499 Ans.	N 21° 46′	220
14	Σ 2497 Aquil.	N 5° 20′	230
14	Σ 2498 Aquil.	N 3° 48′	230
14	26 Ant.	S 5° 39′	221
14	28 Aquil.	N 12° 10′	227
15	B.A.C. 6624 Lyr.	N 40° 9′	346
16	Σ 2504 Ans.	N 18° 57′	220
16	H 5112 Sagittar.	S 18° 14′	384
16	Σ 2505 Lyr.	N 35° 19′	345
16	Σ 2507 Cyg.	N 44° 10′	294

Hour XIX.

m.		Declination	Page
18	Σ 2510 Aquil.	N 9° 17′	231
19	Σ 2513 Aquil.	N 2° 11′	231
19	Σ 41[1] (2, 3) Sagittæ	N 16° 44′	382
20	Σ 2515 Vulp.	N 21° 17′	419
20	Σ 3111 Ans.	N 21° 36′	220
20	4 Ans.	N 19° 34′	220
20	Group Aquil.	N 12° 12′	231
21	Σ 2522 Cyg.	N 28° 32′	292
22	Σ 2519 Ant.	S 9° 46′	222
22	Bu 142 Aquil.	S 12° 23′	230
22	Σ 2523 Ans.	N 20° 57′	220
22	Σ 2524 Cyg.	N 25° 17′	294
22	Σ 2525 Cyg.	N 27° 8′	292
23	P XIX 149 Cyg.	N 36° 17′	290
24	6 Ans.	N 24° 25′	220
24	P XIX 144 Aquil.	N 2° 39′	228
24	Σ 2533 Ant.	S 0° 39′	222
25	* * Cyg.	N 28° 27′	294
26	β Cyg.	N 27° 42′	287
26	B 502 Drac.	N 76° 20′	304
27	P XIX 169 Cyg.	N 28° 1′	290
27	B 505 Sagittar.	S 16° 38′	384
27	Σ 2537 Ant.	S 4° 23′	222
27	Σ 2538 Cyg.	N 36° 28′	293
28	Σ 2540 Ans.	N 20° 9′	220
29	Σ 2542 Cyg.	N 52° 43′	294
29	Group Cyg.	N 28° 20′	295
29	37 Ant.	S 10° 49′	221
29	Σ 2550 Drac.	N 73° 6′	303
30	Σ 2549 Drac.	N 63° 3′	302
31	ε Sagittæ	N 16° 12′	382
31	Σ 44[1] Drac.	N 59° 52′	301
32	Σ 2548 Ans.	N 24° 45′	220
32	Σ 2553 Drac.	N 61° 47′	303
32	Σ 2554 Drac.	N 60° 0′	302
34	R Cyg.	N 49° 56′	295
34	54 Sagittar.	S 16° 34′	383
34	H II 32 Sagittæ	N 16° 18′	382
35	Σ 2571 Drac.	N 78° 0′	302
36	B 509 Cyg.	N 32° 21′	295
37	P XIX 241 Aquil.	N 8° 6′	229
37	Σ 45[1] Aquil.	S 8° 34′	230
37	N 4510. H IV 51 Sagittar.	S 14° 26′	385
38	Σ 2565 Sagittar.	S 13° 31′	383
38	Σ 2573 Drac.	N 60° 13′	301
38	P XIX 250 Aquil.	N 12° 5′	229

Hour XIX.

m.		Declination	Page
38	* * Aquil.	N 0° 50′	232
39	16 Cyg.	N 50° 15′	290
39	O☰ 384 (P XIX 263) Cyg.	N 38° 2′	291
39	P XIX 257 Aquil.	N 10° 29′	229
41	γ Aquil.	N 10° 19′	226
41	☰ 2576 Cyg.	N 33° 20′	293
41	P XIX 276 Cyg.	N 35° 48′	290
41	δ Cyg.	N 44° 50′	287
41	P XIX 278 Cyg.	N 34° 43′	290
42	N 4514. Ḥ IV 73 Cyg.	N 40° 13′	427
42	χ Cyg.	N 33° 27′	288
42	Ḥ 640 Cyg.	N 32° 47′	294
43	☰ 2584 Ans.	N 21° 55′	220
43	π Aquil.	N 11° 31′	227
43	S Vulp.	N 26° 59′	420
43	11 Vulp.	N 27° 1′	420
44	O☰ 386 Cyg.	N 36° 51′	293
44	ζ Sagittæ	N 18° 51′	382
45	Altair	N 8° 33′	226
45	☰ 2587 Aquil.	N 3° 46′	230
46	☰ 2589 Ant.	N 0° 20′	222
46	η Ant.	N 0° 42′	222
47	☰ 2591 Ant.	S 6° 19′	222
47	P XIX 307 Aquil.	N 10° 3′	228
47	O☰ 388 Vulp.	N 25° 32′	419
47	O☰ 389 Cyg.	N 30° 49′	291
48	57 Aquil.	S 8° 32′	227
48	P XIX 320 Vulp.	N 20° 1′	419
48	C 4520. M 71 Sagittæ	N 18° 29′	383
48	☰ 2596 Aquil.	N 14° 57′	230
49	☰ 2597 Aquil.	S 7° 4′	230
49	ε Drac.	N 69° 58′	300
51	☰ 2604 Drac.	N 63° 50′	301
51	10 Sagittæ	N 16° 19′	382
52	η Cyg.	N 34° 46′	296
53	Group Vulp.	N 28° 20′	420
53	ψ Cyg.	N 52° 7′	289
53	B 521 Cyg.	N 43° 56′	295
54	☰ 2617 Drac.	N 75° 6′	304
54	☰ 2606 Cyg.	N 32° 57′	292
54	☰ 2607 Cyg.	N 41° 57′	292
54	☰ 2609 Cyg.	N 37° 47′	291
54	☰ 2610 Cyg.	N 35° 11′	293
54	O☰ 393 Cyg.	N 44° 4′	292
54	N 4532. M 27 Vulp.	N 22° 23′	420
55	☰ 2611 Cyg.	N 47° 2′	293

Hour XIX.

m.		Declination	Page
55	13 Sagittæ	N 17° 11′	382
56	Σ 2612 Aquil.	N 6° 36′	231
56	Σ 2613 Aquil.	N 10° 24′	230
57	Σ 2619 Cyg.	N 47° 57′	293
58	Σ 2618 Aquil.	N 15° 8′	231
59	N 4543. M 75 Sagittar.	S 22° 16′	384
59	H 1470 Cyg.	N 38° 0′	294
59	15 Sagittæ	N 16° 45′	382
59	Σ 2621 Aquil.	N 8° 53′	230
59	Σ 2622 Sagittæ	N 16° 39′	382
59	Σ 2624 Cyg.	N 35° 42′	292

Hour XX.

m.			
0	η Sagittæ	N 19° 39′	382
0	C 4544. H_{IV} VII 59 Cyg.	N 43° 40′	296
0	Σ 2626 Cyg.	N 30° 12′	293
2	Σ 2628 Aquil.	N 9° 3′	230
2	P XIX 415 Vulp.	N 20° 45′	419
2	27 Cyg.	N 35° 39′	296
3	S Cyg.	N 57° 38′	295
4	Red * Cyg.	N 36° 20′	295
4	P XX 2 Aquil.	N 16° 27′	228
4	Σ 2639 Cyg.	N 35° 7′	293
4	Σ 2642 (P XX 30) Drac.	N 63° 22′	304
5	Σ 2636 Aquil.	S 4° 56′	231
5	θ Sagittæ	N 20° 33′	382
5	P XX 12 Ant.	S 0° 29′	221
5	R Capr.	S 14° 37′	264
6	Σ 2645 Cyg.	N 51° 20′	293
6	S Aquil.	N 15° 16′	232
6·5	* * Aquil.	N 9° 48′	232
7	P XX 26 Ant.	N 0° 31′	220
7	Σ 2649 Cyg.	N 31° 44′	293
7	C 4559. H_{IV} VIII 20 Vulp.	N 26° 7′	420
7	Bu 430 Cyg.	N 35° 28′	294
8	Σ 2646 Aquil.	S 6° 24′	230
8	P XX 43 Aquil.	N 6° 13′	229
8	Σ 2651 Aquil.	N 15° 47′	231
9	Σ 2654 Ant.	S 3° 52′	222
9	Σ 2655 Vulp.	N 21° 52′	419
9	B 541 Cyg.	N 38° 22′	295
9	R Sagittæ	N 16° 22′	382
9	R Del.	N 8° 44′	299
10	Σ 2658 Cyg.	N 52° 44′	292
10	Σ 2660 Drac.	N 64° 10′	303
10	B 545 Capr.	S 21° 41′	264

Hour XX.

m.		Declination	Page
10	o^2 Cyg.	N 46° 23′	287
11	α Capr.	S 12° 55′	263
12	32 Cyg.	N 47° 21′	296
12	Σ 2663 Cyg.	N 39° 19′	293
13	P Cyg.	N 37° 39′	295
13	σ Capr.	S 19° 30′	264
13	Σ 2661 Ant.	S 2° 37′	222
13	κ Ceph.	N 77° 21′	270
14	Σ 2664 Del.	N 12° 38′	298
14	Σ 2665 Del.	N 13° 59′	298
14	Σ 2666 Cyg.	N 40° 21′	291
14	Σ 2667 Cyg.	N 45° 15′	294
14	β^2 Capr.	S 15° 10′	263
15	B. A. C. 7001 Cyg.	N 38° 38′	295
15	Σ 2671 Cyg.	N 55° 1′	291
16	Σ 2668 Cyg.	N 39° 2′	292
16	Σ 2670 Aquil.	N 16° 0′	231
16	U Cyg.	N 47° 31′	295
17	R Ceph.	N 88° 46′	274
17	B 554 Cyg.	N 36° 32′	295
18	γ Cyg.	N 39° 52′	296
18	P XX 113 Vulp.	N 23° 41′	419
18	P XX 116 Ant.	N 0° 39′	221
19	Σ 2678 Capr.	S 8° 41′	264
19	Σ 2679 Aquil.	N 19° 11′	230
19	Σ 2680 Del.	N 14° 29′	299
19	C 4575. H VIII 56 Cyg.	N 40° 20′	296
20	Bu 60 (π) Capr.	S 18° 36′	264
21	Σ 2683 Capr.	S 13° 30′	264
21	Σ 2685 Ceph.	N 63° 48′	274
22	P XX 140 Ant.	S 2° 30′	221
22	ρ Capr.	S 18° 13′	264
23	69 Aquil.	S 3° 17′	231
23	o^2 Capr.	S 18° 59′	264
24	Σ 2687 Ceph.	N 56° 15′	272
24	1 Del.	N 10° 30′	297
25	Σ 2691 Cyg.	N 37° 44′	293
25	Σ 2693 Cyg.	N 54° 6′	293
25	Group Vulp.	N 28° 32′	420
26	Σ 2692 Vulp.	N 26° 5′	419
26	P XX 178 Del.	N 10° 51′	297
27	Σ 2696 Del.	N 5° 4′	298
28	ω^2 Cyg.	N 48° 49′	288
28	N 4586. H I 103 Del.	N 6° 59′	299
28	Bu 434 Cyg.	N 41° 27′	294
28	* * Aquil.	N 1° 0′	231

Hour XX.

m.		Declination	Page
29	** Cyg.	N 29° 15′	295
29	C 4591. H VII 8 Cyg.	N 27° 54′	296
29	Σ 2698 Vulp.	N 27° 42′	419
30	Σ 2699 Capr.	S 13° 6′	264
30	Σ 2700 Cyg.	N 32° 5′	291
31	Σ 2701 Del.	N 11° 38′	298
31	Σ 2702 Cyg.	N 34° 45′	294
31	Σ 2703 Del.	N 14° 19′	298
32	β Del.	N 14° 11′	298
33	Σ 2705 Cyg.	N 32° 55′	292
33	48 Cyg.	N 31° 8′	294
33	θ Del.	N 12° 54′	298
34	α Del.	N 15° 29′	298
34	Σ 2707 Cyg.	N 47° 33′	292
34	Σ 2708 Cyg.	N 38° 13′	291
35	Σ 2711 Cyg.	N 30° 4′	293
35	Σ 2713 Del.	N 10° 8′	299
36	49 Cyg.	N 31° 53′	290
37	Σ 2718 Del.	N 12° 17′	298
38	Red * Cyg. (B).	N 47° 43′	427
38	Σ 2720 Del.	N 16° 30′	299
38	S Del.	N 16° 39′	299
38	Σ 2722 Del.	N 19° 17′	299
39	Σ 2723 Del.	N 11° 51′	298
39	Σ 2724 Vulp.	N 23° 30′	419
39	H 1567 Capr.	S 15° 28′	264
40	T Del.	N 15° 58′	299
41	Σ 2725 Del.	N 15° 27′	298
41	γ Del.	N 15° 42′	297
41	13 Del.	N 5° 34′	298
41	U Capr.	S 15° 13′	264
41	52 Cyg.	N 30° 17′	290
42	T Cyg.	N 33° 56′	295
43	OΣ 413 (λ) Cyg.	N 36° 4′	291
43	OΣ 414 Cyg.	N 41° 59′	292
44	B.A.C. 7219 Cyg.	N 45° 8′	295
44	T Aquar.	S 5° 35′	225
45	Σ 2730 Del.	N 5° 57′	298
45	Σ 2732 Cyg.	N 51° 28′	291
47	P XX 355 Eq.	N 6° 53′	306
48	OΣ 416 Cyg.	N 43° 19′	293
48	Σ 2734 Del.	N 12° 38′	299
50	OΣ 418 Cyg.	N 32° 15′	292
50	P XX 376 Eq.	N 4° 5′	305
51	Σ 2736 Del.	N 12° 30′	298
52	B 573 Del.	N 15° 48′	298

Hour XX.

m.		Declination	Page
53	Σ 2738 Del.	N 15° 58′	298
53	ε Eq.	N 3° 50′	305
55	Σ 2739 Del.	N 19° 36′	299
55	P XX 429 Cyg.	N 50° 0′	290
55	Σ 3133 Ceph.	N 60° 52′	272
56	λ (2) Eq.	N 6° 42′	305
56	Σ 2743 Cyg.	N 47° 3′	291
57	Σ 2744 Eq.	N 1° 5′	306
58	N 4628. ♄ IV 1 Aquar.	S 11° 50′	226
58	12 Aquar.	S 6° 18′	223
58	Σ 2747 Cyg.	N 37° 10′	293
58	P XX 452 Cyg.	N 39° 2′	290
59	R Vulp.	N 23° 21′	420
59	Σ 2751 Ceph.	N 56° 12′	271

Hour XXI.

m.			
1	Σ 2754 Del.	N 12° 43′	299
1	61 Cyg.	N 38° 9′	288
2	Σ 2760 Cyg.	N 33° 38′	292
2	Σ 2761 Vulp.	N 24° 0′	419
3	Σ 2764 Ceph.	N 61° 41′	273
3	Neb. Cyg.	N 41° 45′	401
3	Σ 2771 Ceph.	N 70° 15′	274
4	Σ 2766 Ceph.	N 58° 31′	273
4	P XXI 1 Cyg.	N 29° 43′	290
5	Σ 2765 Eq.	N 9° 3′	306
5	Σ 2767 Peg.	N 19° 29′	370
5	γ Eq.	N 9° 39′	306
5	Σ 2769 Vulp.	N 21° 58′	419
6	Σ 2773 Cyg.	N 43° 31′	294
7	OΣ 431 Cyg.	N 40° 45′	292
8	T Ceph.	N 67° 54′	274
9	δ Eq.	N 9° 31′	306
9	P XXI 51 Ceph.	N 59° 30′	271
9	Σ 2779 Cyg.	N 28° 36′	294
10	α Eq.	N 4° 45′	306
10	Σ 2781 Aquar.	S 8° 9′	225
10	OΣ 432 (P XXI 50) Cyg.	N 40° 40′	291
10	B 579 Ceph.	N 59° 37′	274
10	τ Cyg.	N 37° 32′	294
11	Σ 2783 Ceph.	N 57° 48′	273
14	Σ 2786 Eq.	N 8° 58′	306
15	Σ 2787 Eq.	N 1° 30′	306
15	9 Eq.	N 6° 51′	306
15	T Capr.	S 15° 40′	264
16	OΣ 437 Cyg.	N 31° 56′	291

Hour XXI.

m.		Declination	Page
16	Σ 2789 Cyg.	N 52° 28′	292
16	Σ 2790 Ceph.	N 58° 7′	271
17	1 Peg.	N 19° 17′	368
17	β Eq.	N 6° 18′	305
17	Σ 2796 Ceph.	N 78° 5′	272
18	B 582 Cyg.	N 41° 53′	295
18	Σ 2791 Eq.	N 3° 52′	306
19	Σ 2793 Eq.	N 8° 52′	306
19	Σ 55[1] Cyg.	N 36° 51′	291
21	Σ 2797 Peg.	N 13° 10′	370
22	Σ 2801 Ceph.	N 79° 50′	272
23	Σ 2799 Peg.	N 10° 34′	370
24	C 4670. M 15 Peg.	N 11° 38′	372
25	β Aquar.	S 6° 6′	223
25	Σ 2807 Ceph.	N 82° 1′	273
26	Σ 2803 Cyg.	N 52° 25′	292
27	Σ 2802 Cyg.	N 33° 17′	293
27	Σ 2804 Peg.	N 20° 11′	370
27	N 4678. M 2 Aquar.	S 1° 22′	225
27	β Ceph.	N 70° 2′	270
28	C 4681. M 39 Cyg.	N 47° 54′	296
30	ρ Cyg.	N 45° 4′	295
31	Σ 2809 Aquar.	S 0° 55′	224
31	Σ 2810 Ceph.	N 58° 34′	273
31	Σ 2812 Ceph.	N 59° 10′	274
32	Σ 2813 Ceph.	N 56° 56′	274
32	Σ 57[1] Ceph.	N 66° 12′	272
32	B 587 Cyg.	N 44° 50′	295
32	3 Peg.	N 6° 5′	368
34	OΣ 445 Peg.	N 20° 11′	371
34	OΣ 447 Cyg.	N 41° 10′	291
34	N 4687. M 30 Capr.	S 23° 42′	264
35	P XXI 248 Ceph.	N 56° 57′	271
36	Σ 2817 Aquar.	S 0° 8′	225
36	Σ 2819 (P XXI 256) Ceph.	N 57° 1′	273
37	S Ceph.	N 78° 5′	274
37	*Nova* (1876) Cyg.	N 42° 20′	295
38	ε Peg.	N 9° 20′	368
38	B 592 Cyg.	N 37° 28′	295
39	μ Cyg.	N 28° 12′	288
39	κ Peg.	N 25° 6′	368
40	μ Ceph.	N 58° 14′	274
40	Σ 2825 Aquar.	N 0° 17′	225
40	Σ 2827 Ceph.	N 63° 3′	274
41	Σ 2826 Capr.	S 13° 41′	264
43	Σ 2828 Peg.	N 2° 50′	371

Hour XXI.

m.		Declination	Page
43	Σ 2837 Ceph.	N 82° 22′	273
44	Σ 2829 Peg.	N 30° 9′	371
45	Σ 2832 Cyg.	N 49° 58′	293
48	Σ 2838 Aquar.	S 3° 51′	224
48	Σ 2840 Ceph.	N 55° 14′	271
48	OΣ 451 (P XXI 328) Ceph.	N 61° 3′	272
49	Σ 2841 Peg.	N 19° 9′	369
49	Σ 2843 Ceph.	N 65° 12′	270
49	Σ 2845 Ceph.	N 62° 31′	273
50	OΣ 452 Peg.	N 6° 41′	370
51	Group Peg.	N 7° 4′	373
51	OΣ 456 Cyg.	N 51° 57′	293
51	B 598 Cyg.	N 49° 57′	295
51	Σ 2858 Ceph.	N 86° 19′	273
52	Σ 2847 Aquar.	S 4° 4′	224
52	Σ 2848 Peg.	N 5° 22′	370
53	B 599 Ceph.	N 63° 3′	274
55	Σ 2851 Aquar.	S 12° 35′	225
56	Σ 2852 Cyg.	N 53° 35′	294
56	29 Aquar.	S 17° 32′	223
58	Σ 2854 Peg.	N 13° 4′	370
59	Σ 2860 Ceph.	N 60° 16′	273

Hour XXII.

m.			
0	Σ 2857 Peg.	N 9° 29′	370
0	ξ Ceph.	N 64° 3′	270
0	Σ 2861 Peg.	N 20° 15′	370
1	Σ 2862 Aquar.	S 0° 1′	224
1	R Peg.	N 9° 54′	372
3	35 Aquar.	S 19° 4′	225
3	T Peg.	N 11° 57′	372
3	Σ 2873 Ceph.	N 82° 17′	271
4	Σ 2867 Peg.	N 7° 19′	371
4	Σ 2868 Peg.	N 21° 57′	371
4	Σ 2870 Ceph.	N 60° 31′	273
4	π^1 Peg.	N 32° 35′	368
5	P XXII 11 Ceph.	N 58° 42′	271
7	Σ 2876 Lac.	N 37° 3′	327
8	41 Aquar.	S 21° 40′	223
8	Σ 2883 Ceph.	N 69° 32′	271
9	Σ 2878 Peg.	N 7° 23′	369
9	Σ 2881 Peg.	N 29° 0′	370
9	Σ 2882 Lac.	N 37° 8′	327
9	P XXII 33 Peg.	N 16° 36′	369
10	C 4773. ♅ VIII 75 Lac.	N 49° 17′	328
11	Σ 2887 Aquar.	S 1° 19′	225

Hour XXII.

m.		Declination	Page
11	Σ 2890 Lac.	N 49° 16′	327
11	Σ 2891 Lac.	N 47° 23′	327
11	Σ 2893 Ceph.	N 72° 44′	271
14	P XXII 65 Lac.	N 37° 10′	327
14	Group Lac.	N 45° 23′	328
15	OΣ 469 Lac.	N 34° 31′	327
15	Σ 2896 Ceph.	N 62° 37′	273
18	Σ 2901 Peg.	N 3° 13′	372
18	Σ 2902 Lac.	N 44° 45′	327
18	Σ 2903 Ceph.	N 66° 6′	272
18	33 Peg.	N 20° 15′	369
20	53 Aquar.	S 17° 21′	224
21	Σ 2905 Peg.	N 14° 33′	371
22	Σ 2908 Peg.	N 16° 39′	370
23	Σ 2910 Peg.	N 22° 55′	371
23	ζ Aquar.	S 0° 38′	223
24	Σ 2913 Aquar.	S 8° 43′	224
25	δ Ceph.	N 57° 48′	270
26	Σ 2915 Peg.	N 6° 45′	372
26	Σ 2916 Lac.	N 40° 38′	327
26	Σ 2917 Lac.	N 52° 55′	327
26	7 Lac.	N 49° 40′	328
28	Σ 2920 Peg.	N 3° 36′	370
29	η Aquar.	S 0° 44′	225
30	Σ 2923 Ceph.	N 69° 45′	272
31	8 Lac.	N 39° 1′	327
32	Σ 2926 Lac.	N 38° 16′	327
33	Σ 2928 Aquar.	S 13° 14′	225
35	Σ 3134 Peg.	N 29° 24′	372
36	Σ 2934 Peg.	N 20° 48′	371
37	P XXII 200 Aquar.	S 8° 56′	224
37	η Peg.	N 29° 36′	372
39	Σ 2942 Lac.	N 38° 51′	327
41	OΣ 480 Ceph.	N 57° 26′	273
41	τ^1 Aquar.	S 14° 41′	224
42	P XXII 219 Aquar.	S 4° 51′	224
43	τ^2 Aquar.	S 14° 13′	225
44	Σ 2945 Peg.	N 30° 41′	371
44	Σ 2946 Lac.	N 39° 52′	327
45	Σ 2947 Ceph.	N 67° 55′	272
45	Σ 2948 Ceph.	N 65° 55′	272
46	Σ 2950 Ceph.	N 61° 4′	271
49	Σ 2954 Peg.	N 14° 35′	372
50	Σ 2952 *rej.* Peg.	N 27° 20′	372
51	S Aquar.	S 20° 59′	225
52	Σ 2961 Ceph.	N 62° 15′	273

Hour XXII.

m.		Declination.	Page
52	Σ 2963 Ceph.	N 75° 45′	273
53	OΣ 483 (52) Peg.	N 11° 5′	369
54	Σ 2971 Ceph.	N 77° 51′	272
56	Σ 2970 Aquar.	S 11° 59′	225
58	β Peg.	N 27° 26′	372
59	Σ 2974 Peg.	N 32° 44′	371
59	Σ 59[1] (83, 84) Aquar.	S 8° 12′	224

Hour XXIII.

m.			
2	P XXII 306 Peg.	N 32° 11′	369
3	Σ 2981 Aquar.	S 9° 29′	225
4	π Ceph.	N 74° 44′	270
4	Σ 2985 And.	N 47° 19′	216
4	57 Peg.	N 8° 2′	368
6	Σ 2988 Aquar.	S 12° 33′	224
7	Σ 2990 Peg.	N 21° 27′	371
7	H 3176 Peg.	N 11° 53′	372
8	Σ 2993 Aquar.	S 9° 35′	224
8	Σ 2991 *rej.* Peg.	N 10° 30′	372
9	Σ 2996 Ceph.	N 81° 10′	273
10	Σ 2995 Aquar.	S 2° 15′	224
10	ψ[1] Aquar.	S 9° 44′	223
10	Group Aquar.	S 5° 10′	226
11	Σ 2997 Peg.	N 20° 44′	372
13	94 Aquar.	S 14° 7′	223
13	Σ 3000 Peg.	N 24° 33′	372
14	o Ceph.	N 67° 27′	271
14	S Peg.	N 8° 16′	372
15	OΣ 494 Peg.	N 21° 18′	370
16	Σ 3006 Peg.	N 34° 47′	372
17	Σ 3008 (P XXIII 69) Aquar.	S 9° 7′	224
18	Σ 3009 Pisc.	N 3° 2′	380
18	Σ 3010 And.	N 45° 9′	217
19	C 4957. M 52 Ceph.	N 60° 56′	275
20	Σ 3011 Ceph.	N 76° 26′	273
21	Σ 3013 Peg.	N 16° 0′	370
21	κ[1] Pisc.	N 0° 36′	381
21	N 4964. H IV 18 And.	N 41° 52′	219
23	Σ 3017 Ceph.	N 73° 29′	272
24	Σ 3019 Pisc.	N 4° 37′	380
24	P XXIII 101 Cass.	N 57° 53′	266
25	Σ 3021 Peg.	N 15° 34′	370
25	OΣ 497 Peg.	N 8° 49′	371
26	Σ 3024 And.	N 43° 10′	217
28	Group Aquar.	S 10° 40′	226
29	Σ 60[1] Cass.	N 59° 47′	266

Hour XXIII.

m.		Declination	Page
34	Σ 3030 Pisc.	S 1° 3′	381
35	Σ 3031 Pisc.	N 5° 37′	380
36	OΣ 503 Peg.	N 19° 38′	370
36	B.A.C. 8245 And.	N 44° 20′	218
37	ω^2 Aquar.	S 15° 12′	225
38	Σ 3033 Pisc.	N 6° 34′	381
38	R Aquar.	S 15° 57′	225
40	B 648 (19) Pisc.	N 2° 49′	381
40	Σ 3037 Cass.	N 59° 48′	267
40	Σ 3038 Cass.	N 61° 59′	268
40	107 Aquar.	S 19° 21′	223
42	Σ 3041 Peg.	N 16° 25′	371
43	OΣ 508 (6) Cass.	N 61° 33′	267
46	Σ 3042 And.	N 37° 14′	216
47	Σ 3043 And.	N 38° 2′	217
47	P XXIII 216 Peg.	N 11° 15′	369
50	Σ 3046 Cet.	S 10° 10′	277
51	C 5031. H VI 30 Cass.	N 56° 3′	269
52	Σ 3047 Cass.	N 56° 43′	268
52	P XXIII 240 And.	N 23° 41′	216
52	R Cass.	N 50° 43′	269
53	σ Cass.	N 55° 5′	266
53	Bu 730 (27) Pisc.	S 4° 13′	429
53	Σ 3050 And.	N 33° 4′	216
55	B 658 Cass.	N 59° 41′	268
56	Bu 733 (85) Peg.	N 26° 27′	369
56	Σ 3052 Ceph.	N 70° 42′	272
57	Σ 3053 Cass.	N 65° 24′	267
57	Σ 3054 Pisc.	N 7° 36′	380
59	OΣ 547 And.	N 45° 9′	217
59	Σ 3058 And.	N 29° 42′	217

APPENDIX III.

TELESCOPIC OBJECTS IN THE SOUTHERN HEMISPHERE.

(From Sir J. F. W. Herschel's Observations at the Cape of Good Hope.)

THE following selection of objects for students in S. Latitudes (which, in the present impression, has been much enlarged and improved by the kindness of Messrs. Franks and Sadler) has been made without that personal knowledge which is so important when an author's materials are to be adapted to a purpose not contemplated by himself; and this disadvantage will, it is hoped, be regarded in extenuation of defective and unequal execution. The arrangement is that of Right Ascension, without reference to constellations, which in the Southern have not an equal claim to respect, on the ground of ancient custom, with those in the Northern hemisphere.

(A) DOUBLE STARS.

N.B.—The data in the following list are merely approximate. The *numbers* are those of H, except a few supplied from the British Association Catalogue and Burnham. Mean values have been taken, where not given by H. General Epoch, 1880.

Name	R. Asc.	Dec. S.	Pos.	Dist.	Mags.
	h. m.	° ′	°	″	
κ^1 Sculpt. (Bu 391)	0 3	28 39	110	0·7	6, 6
β Touc. . .	0 26	63 38	172	28	5, 5
ξ Appar. . .	0 28	35 39	164	6	6, 9
λ Touc. . .	0 48	70 9	79	21	7, 8[a]
3416 Touc. . .	0 58	60 44	127	5	8, 8[b]
β Phœn. . .	1 1	47 22	18	30	3·5, 11
3436 Sculpt. . .	1 21	30 51	124	13	7·5, 9
3447 Appar. . .	1 31	30 34	75	3	6, 7[c]
6 (p) Erid. . .	1 35	56 48	122·3	3 65	6, 6[d]
ϵ Sculpt. . .	1 40	25 39	70	6	6, 10
ω Forn. . .	11 29	28 46	242	11	5, 8
Bu 261 Forn. .	11 39	28 25	110	2	7, 10
3527 Erid. . .	11 39	41 2	43	1·5	7, 7
υ Forn. . .	11 44	37 54	151	8 est.	6, 7
θ Erid. . . .	11 54	40 47	81	9	5, 6

[a] Bin. ? [b] Triple, 11 mⁿ. [c] 1837.—Cin. 90°·6, 1877. Var ? [d] 1835.—Russell 234°·4 : 6″·3, 1880; Do bin. 117·5y.

Name	R. Asc.	Dec. S.	Pos.	Dist.	Mags.
	h. m.	° ′	°	″	
12 Erid.	III 7	29 28	310	5	3, 8[a]
f Erid.	III 44	37 59	200	9	5, 5
3621 Erid.	III 59	34 10	110	15	8·5, 8·5
θ Retic.	IV 16	63 33	6	6	5, 9
3679 Hydri	IV 35	62 19	350	20	7, 12[b]
ι Pict.	IV 48	53 40	58	12	5. 6
3728 Columb.	V 5	41 23	262	14	6·5, 11
3735 Columb.	V 9	32 3	151	7·6	8, 8
3760 Columb. (Triple)	V 22	35 27	221, 270	7, 20	7, 7. 11
θ Pict.	V 22	52 25	286	38	6, 6
3823 Columb.	V 56	31 4	132	3	9, 9
3835 Pict.	VI 2	48 27	163	4	8, 8[c]
3857 Can. Maj. (Triple)	VI 20	36 39	258, 66	12, 70	5·5, 12, 7
3858 Can. Maj.	VI 21	33 57	314	3	7·5, 8
3871 Can. Maj.	VI 30	29 32	353	10	7·5, 8
V Pupp.	VI 35	48 7	317	13	5, 7
B. A. C. 2207 Can. Maj.	VI 38	38 17	276	8	6. 8
3895 Arg.	VI 42	47 37	61	25	7. 11
3928 Can. Maj.	VII 1	34 36	158	5	6, 8[d]
B. A. C. 2336 Arg.	VII 1	59 0	74·9	2·4	6, 7[e]
γ Volant.	VII 10	70 18	301	13	5, 7
3966 Arg.	VII 21	37 3	141	7	7, 7
B. A. C. 2477 Arg.	VII 24	31 36	52	10	6. 7
σ Arg.	VII 25	43 4	75	22	5, 10
4028 Arg.	VII 56	49 39	47	17	7, 7
4030 Arg.	VII 57	40 58	345	40	7. 9[f]
Bu 203 Arg.	VII 58	27 14	246	5	7, 10
K Pupp.	VIII 6	42 17	80	6	7 8
γ Arg. (Triple)	VIII 6	46 59	220, 152	41, 62	2, 6, 8[g]
ε Volant.	VIII 8	68 16	23	7	5. 10
4058 Arg.	VIII 10	35 32	190	4	6, 7
4063 Arg.	VIII 11	36 58	346	20	8, 9·5
4104 Arg. (Triple)	VIII 25	47 32	242, 40	4. 20	6, 9, 10
B. A. C. 2866 Arg.	VIII 25	44 19	350	6	6. 9
4115 Arg. (Triple)	VIII 33	33 19	156. 21	20. 40	6·5, 12, 13
4127 (*b*) Velor.	VIII 37	46 12	58	30	5, 11
4128 Arg.	VIII 37	59 54	222	3	7, 8
Bu 410 Arg.	IX 5	25 19	160	1·5	7, 9

[a] Cin. 316°: 2″·4, 1877.—3 var. ? [b] 7 very high red. [c] Jacob angle changing, and closing, 1856–7–8. [d] Quadruple. [e] 1836.—Jacob 78°: 3″, 1847. [f] White, rich ruby, approaching sanguine. [g] Spectrum with bright lines.

Name	R. Asc.	Dec. S.	Pos.	Dist.	Mags.
	h. m.	° ′	°	″	
ε Mal. . . .	IX 6	29 49	145	18	6·5, 9·5
4188 Arg. . .	IX 8	43 7	287	3	6, 7
ζ Antl. . . .	IX 26	31 22	211	8	6, 7
4220 Velor. . .	IX 29	48 28	202	3	6, 7
υ Arg.	IX 44	64 31	126	5	3, 8
B. A. C. 3396 Arg.	IX 50	44 43	239	6	6, 10
T Velor. (Triple) .	X 16	55 26	103, 191	7, 37	5, 10, 10
s Velor. . .	X 27	44 27	38	14	6, 6
4383 Musc. . .	X 50	70 5	286	1·5	7. 8
4421 Cent. . .	XI 10	47 16	69	12	6·5. 10
4432 Carin. . .	XI 18	64 18	288	2	6. 8
B. A. C. 3907 Cent.	XI 23	42 1	167	13	6. 8
4455 Crat. (F 22 Hyd.) . .	XI 31	32 54	245	4	6, 9
4463 Hyd. . .	XI 35	32 55	248	2·5	6, 8
β Crat. . . .	XI 47	33 14	340	2	5, 5[a]
ε Cham. . .	XI 54	77 33	178	1·5	6, 6
B. A. C. 4115 Cent.	XII 8	45 3	247	4	5, 7
α Cruc. . .	XII 20	62 26	121, 202	6, 91	2, 2, 6[b]
γ Cruc. . .	XII 25	56 26	38	120	2, 5
γ Cent. . .	XII 35	48 18	351	0·75	4. 4[c]
4554 Hyd. . .	XII 45	30 26	28	18	6, 10
4563 Cent. . .	XII 54	32 58	237	7	7. 9
ξ[2] Cent. . .	XIII 0	49 16	100	26	5, 10
θ Musc. . .	XIII 0	64 40	187	6·	6, 9
f Hyd. . . .	XIII 30	25 53	191	10	6, 7
Q Cent. . .	XIII 34	53 57	164	5	6, 7
k Cent. . .	XIII 45	32 24	113	9	6. 7
Bu 343 Cent. .	XIII 45	31 1	120	1·2	6, 8·5
h Cent. . . .	XIII 46	31 20	186	13·8	5, 10
4649 Cent. . .	XIV 1	59 9	64	12	9, 9[d]
Y Cent. (Triple) .	XIV 14	57 55	163, 2	10, 35	6, 8, 11
α Cent. . . .	XIV 31	60 20	219·6	16·5	1, 2[e]
α Circ. . . .	XIV 33	64 27	244	16	4. 9
Bu 414 Cent. .	XIV 35	30 25	160	1	6·5, 6·5
Bu 347 Cent. .	XIV 47	32 49	340	10	6, 10
4715 Lup. . .	XIV 48	47 24	278	3	6, 7
π Lup. . . .	XIV 57	46 35	111	0·75	5, 5[f]
κ Lup. . . .	XV 4	48 17	144	27	5, 6
4746 Circ. . .	XV 6	58 38	—	—	multiple[g]

[a] Probably unchanged. Not β, but 28, of S.D.U.K. Map. [b] Bin. ? [c] 1835.—Russell 1″·3 : 1″·4, 1880. [d] Both full scarlet.—B 319. [e] Most striking of its kind in the heavens, and nearest to us yet known. Bin. Hind 85y. Do 88·5y. Elkin 77·4y. [f] 112°·8, 1835; Jacob 106°·2 : 1″·2, 1848. [g] Ten or more, 12 or 13 mg. within 45′ of 8 mg. Rare. Another 4962, *infra*, XVII[h] 26[m], S 32° 30′.

Name	R. Asc.	Dec. S.	Pos.	Dist.	Mags.
	h. m.	° ′	°	″	
Bu 350 Lib. . .	xv 8	27 9	170	1 3	6·5, 8
μ^1 Lup. (Triple) .	xv 10	47 26	174, 131	2. 23	6, 6, 8
γ Circ. . . .	xv 14	58 53	108	1·25	5, 6
ϵ Lup. . . .	xv 15	44 15	175	26	4, 9·5
γ Lup. . . .	xv 27	40 46	94	0 75	4, 4
f Lup. . . .	xv 28	44 33	349	3	5, 9
ξ Lup. . . .	xv 49	33 37	49	11	6. 6
η Lup . . .	xv 52	38 3	22	15	4. 8
12 Scorp. . .	xvi 5	28 6	82	4·6	6·5, 10
4848 Scorp. . .	xvi 16	32 55	155	6	7. 7
4850 Scorp. . .	xvi 17	29 25	348	8	6. 7
ϵ Norm. . .	xvi 18	47 17	335	24	5, 7
4866 Ar. . .	xvi 30	56 46	126	4	7, 8
4876 Ar. . . .	xvi 32	48 32	265	10	6, 7[a]
4901 Ar. . .	xvi 51	58 41	134	3	8, 8
Bu 416 Scorp. (Triple) . .	xvii 11	34 51	240, 130	1·8, 15	6. 8·5, 10
4949 Ar. (Triple) .	xvii 18	45 44	267, 313	3. 104	6, 7. 7
Bu 128 Oph. .	xvii 20	26 9	340	4	7·5. 10
4962 Scorp. . .	xvii 27	32 30	102	8	6·5. 13 (mult.)
5003 Sagit. . .	xvii 51	30 14	107	6	6. 7
5014 Coron. . .	xvii 59	43 21	69	0·75	6, 6[b]
Bu 245 Sagit. .	xviii 2	30 45	355	3·5	6, 10
Bu 285 Sagit. (Quadruple)	xviii 9	25 3	317	1·5	8·5, 11
	—	—	30	1·5	8·5. 12
5041 Telesc. . .	xviii 16	53 42	260	2	7. 9
Bu 133 Sagit. .	xviii 20	26 42	270	1·8	7·5, 7·5
κ Coron. . .	xviii 25	38 48	359	22	6. 7
γ Coron. . .	xviii 58	37 14	37 1	2·7	6, 6[c]
5093 Coron. (Triple) . . .	xix 4	43 20	220, 214	20, 10	8, 10, 11
β^1 Sagit. . .	xix 14	44 41	79	29	4, 8
B. A. C. 6782 Telesc.	xix 43	55 17	151	23	6, 7
Bu 153 Capr. .	xx 40	26 51	270	1·5	7. 10
B. A. C. 7191 Pav.	xx 42	62 52	101	3	7, 7
α Micr. . . .	xx 42	34 13	164	22	5, 11
Bu 251 Pisc. Aust. .	xxi 5	31 5	250	2·5	7, 10
θ Ind. . . .	xxi 11	53 57	307	4	5. 10[d]
Bu 271 Pisc. Aust.	xxi 13	26 51	250	1·8	7, 10
λ Oct. . . .	xxi 32	83 16	83	3	6, 9
θ Pisc. Aust. . .	xxi 41	31 27	334	25	5, 13

[a] Quadruple. [b] Rapid bin. ? [c] ·834.—Cin. 242°·6 : 1‴·4, 1878. Bin. Sehl. 55·6y.
[d] Moving.

Name	R. Asc.	Dec. S.	Pos.	Dist.	Mags.
	h. m.	° ′	°	″	
η Piscis Austr. (Bu 276)	XXI 54	29 2	120	1·8	5, 6
β Piscis Austr.	XXII 25	32 58	173	29	4, 8
5356 Piscis Austr. (Triple)	XXII 33	28 58	160. 58	85, 4	6, 7, 9
γ Piscis Austr.	XXII 46	33 31	277	4	4. 10
B. A. C. 8046 Gru.	XXIII 0	51 20	260	8	6, 7
ψ Gru.	XXIII 17	54 28	213	27	6, 7
θ Phœn.	XXIII 33	47 18	269	4	6, 7

(B) RED STARS.

(*N.B.*—Several of these are visible in our latitudes.)

R. Asc.	Dec. S.	Mag.	H's Description.
h. m.	° ′		
1 21	33 10	6	Most beautiful orange red. (B 24.—R *Sculptoris*, var. 5·75–7·75 in 207^{d}? Gould one of the most brilliantly coloured in the heavens, intense scarlet all through.)
V 40	46 31	8	Vivid sanguine red, like a blood-drop. A superb specimen of its class. (B 124.)
VI 19	26 59	8	Very intense ruby. (B 145.)
VII 18	25 32	7	Very intense fiery red. (B 175.)
VII 42	31 50	9	Very fine ruby. (B 190.)
IX 29	62 16	8	Very intense sanguine. (B 225. Gould var. 6·5–10.)
IX 51	41 1	7·5	Scarlet; remarkably full rich colour. (B 230.)
X 7	34 44	7	Scarlet. (B 235.)
X 30	38 57	6·5	Extreme orange, almost scarlet. (B 240. Brisbane dusky yellow; plan. disc. Gould brilliant red.)
XI 5	81 8	8	Ruby, almost sanguine. (B 255.)
XI 34	71 54	8·5	Fine ruby, inclining to scarlet. (B 264.)
XII 40	59 2	8·5	In field with β *Crucis*, the fullest and deepest maroon red. H's most intense; like a drop of blood when contrasted with β. (B 291.)
XV 3	69 38	6	Almost scarlet. (B 345.)
XV 13	75 30	7	Very high red. (B 347.)
XVI 33	32 8	8	Deep red, like a drop of blood. (B 385.)
XVII 32	41 33	8	Beautiful ruby red. (B 414.)
XX 0	27 34	7·5	Fine ruby. (B 526.)
XX 21	28 39	8	Fine ruby. (B 559.)

(190 Argûs, about VII^h 34^m, 37° 30′, is mentioned by Freeman as a singularly red star in a fine field.)

We may place here that most wonderful variable, η Argûs (x^h 40^m, 59° 3′), whose changes have attracted so much attention of late years. 1677, 4m^s. 1751, 2m^s. 1811–15, 4m^s. 1822–26, 2m^s. 1827, 1m^s. 1828–33, 2m^s. 1838–43, 1m^s. 1843–50, nearly or quite equal to Sirius, with some strange fluctuations. 1845–48. Lost to nearly all eyes 1862, or as others 1864. 1865, 5m^s.—Wolf thinks a period possible of 46y. with two subordinate *maxima* and *minima*. Loomis prefers 70y.—Red, or or.-red. Le Sueur, with the great Melbourne refl., finds its spectrum crossed by bright lines.

This star was seen by H, 1838, encompassed by dense nebulosity. 1860–62, Powell noticed it much fainter and changed in form. Ellery with Melbourne refl. finds very rapid change.

Canopus was thought, 1861, in Chili, brighter than Sirius. (*Astron. Nachr.* 1311.)

ϵ Crucis. Lettsom, 1860, found this star 6m^s. instead of 4m^s. as in Map. Houzeau, 1875, 4·5m^s.

(C) CLUSTERS AND NEBULÆ.

The two Magellanic Clouds, or Nubecula Major and Minor, are of the most complex nature:—large tracts of nebulosity, irresolvable and in every stage of resolution, with clustering groups, nebulæ of all kinds, globular clusters, and nebulous objects of unique character. The N. Major contains 278 clusters and nebulæ, with 50 or 60 outliers; the Minor 37, with 6 adjacent. They combine what are elsewhere strikingly separated, the galactic and the nebular system.

The Galaxy from Centaurus to Argo was all resolvable on a dark ground with H's 18½-inch specula, front view.

The numbers in the following list are those of H's 'General Catalogue.' A few of them might be seen in our latitudes.

No.	R. A.	Dec. S.	H's Description
	h. m.	° ′	
52	0 19	72 45	Most glorious globular cluster; stupendous object; completely insulated: stars all nearly 12—14m^s. Central blaze ruddy, rest white. 47 Toucani, *p Nubec. Minor.*
138	0 42	25 57	Very bright large neb. 24′ × 3′.
162	0 46	27 18	Bright cl. 5′ diam. 12—16 m^s.
165	0 47	74 0	Centre of *Nubec. Minor*, a partially resolved cloud, 11—18m^s. in a most barren region.
183	0 52	73 7	Bright knot of 13—15m^s. stars.
193	0 57	71 30	Cl. 13—14m^s.; central blaze.
361	1 29	30 1	Bright large neb.
697	III 18	37 39	Bright neb.; stellar nucleus, 2″. (Another 7′*n*.)
731	III 29	36 32	Very bright nucleus, resolvable? between two lengthened parallel clouds of haze.
744	III 32	35 54	Bright cl.

No.	R. A.	Dec. S.	H's Description
	h. m.	° ′	
748	III 34	35 51	Ditto, resolved?
769	III 39	36 30	Bright cl.
808	IV 0	43 40	Cl. just *n.* of great group of large stars, 6—8m^s.
982	IV 57	66 35	Bright large neb. (Many of the following, to 1350, are in *Nub. Maj.*)
1009	V 1	38 10	Ditto, resolvable?
1031	V 4	66 36	Bright cl.
1032	V 4	67 25	Cl. in radiating streaks.
1060	V 10	68 54	Fine large cl. 13m^s.
1061	V 10	40 11	Superb cl. 14—16m^s.; central blaze.
1065	V 10	68 59	Bright cl. 12m^s.
1079	V 14	67 31	Large cl.
1109	V 18	68 43	Ditto.
1181	V 29	66 20	Large oval neb.
1207	V 31	67 23	Cl. 12—14m^s.
1230	V 35	67 0	Large cl. 9—11m^s.
1269	V 40	69 10	'Great looped neb.' round 30 Doradûs, in *Nub. Maj.* visible to naked eye: Le Sueur gaseous. Burton continuous spectrum with one bright line. Change?
1298	V 43	69 16	Cl. 13—16m^s.
1328	V 53	59 56	Group of bright and smaller stars.
1350	V 58	69 12	Bright cl.
1404	VI 18	44 42	Cl. coarse, brilliant; chief, 8m^s.
1543	VII 26	16 57	Brilliant group, 8—10m^s.
1573	VII 41	37 41	Very large bright cl.; one 4·5m^s. orange.
1593	VII 48	38 14	Beautiful large cl. 12 or 13m^s.
1598	VII 50	23 59	Very rich milky-way cl. 10—12m^s.
1619	VII 57	60 33	Large brilliant cl. 7—13m^s.; orange star in middle. Visible to naked eye.
1636	VIII 7	48 55	Ditto, 7—16m^s.
1783	IX 8	41 56	Plan. neb. 6″ diam. bright as 9m^s.
1793	IX 10	64 22	Superb cl. 13—15m^s., 'like the finest dust;' central blaze.
1801	IX 11	36 7	Cl. containing neb. nearly plan. like M 46 (Argûs, *antea*).
1843	IX 18	57 48	Plan. neb., perfectly sharp and round; 8″; white.
1881	IX 31	46 23	Very large cl. from 8m^s. 'Telescopic Præsepe.'
2007	IX 59	59 32	Very large loose cl. 9—14m^s.
2017	X 2	39 51	Plan. neb. large; elliptic; enclosing star 9m^s.
2197	X 40	59 3	Great diffused branching milky neb. with interior darkness, about η Argûs [probably gaseous].

No.	R. A.	Dec. S.	H's Description
	h. m.	° ′	
2308	XI 1	58 1	Glorious cl. 8—12m.s. Most brilliant H had ever seen.
2468	XI 31	60 56	Large cl. 8—13m.s. 150 to 200 stars.
2573	XI 44	47 36	Ditto, 9—14m.s.
2581	XI 44	56 31	Plan. neb. 12″; beautiful rich blue; bright as 7m.s. Or. 8m.s. ± 10′ n.
3128	XII 33	26 5	M 68. Cl. 12m.s. One red.
3275	XII 47	59 42	Vivid and beautiful cl. 50 to 100, of various colours, some greenish, round κ Crucis, extremely red. Abbott (1862) suspected changes in number, position, and colour.
3466	XIII 9	62 47	Great milky-way cl. 34,11m.s. 150 or 200 smaller.
3531	XIII 20	46 41	'Most glorious object;' cl. of full 20′, thousands of stars of 2m.s. 12 and 13 only (or 13 and 15); perhaps from optical coincidence; the larger like lace-work; two darker spaces in centre. Hazy 4 or 5m.s. star to naked eye, ω Centauri.
3922	XIV 27	56 2	Bright cl. 9—13m.s. 7m.s. red or yellow, central.
4066	XV 9	45 13	Plan. neb., most elegant and delicate; perfectly sharp; 4″; white.
4100	XV 19	54 6	Cl. 11—14m.s., in pairs and small groups, on a black ground.
4153	XV 53	60 10	Brilliant cl. from 7m.s.
4162	XVI 4	53 54	Superb cl. 20′; 10—15m.s.
4170	XVI 9	57 36	Coarse brilliant cl. 7—10m.s.
4184	XVI 17	40 23	Cl. 50 or 60; 9—11m.s.
4307	XVII 27	44 39	Cl. 4′; 17—20m.s., excessively close.
4318	XVII 32	32 8	M 6. Cl. 7—10m.s.
4332	XVII 42	37 1	Cl. 18—20m.s., central blaze. γ Telesc. in field.
4340	XVII 46	34 47	M 7? Brilliant cl. 60, 7—12m.s.
4411	XVIII 24	32 26	M 69. Cl. 14—16m.s.
4428	XVIII 35	32 24	M 70. Cl. 14—17m.s.
4442	XVIII 47	30 37	M 54. Cl. 15m.s.
4503	XIX 32	31 13	M 55. Cl. 12—15m.s.

APPENDIX IV.

METEOR SHOWERS.

THE admission of these wonderful displays amongst astronomical phænomena is now undisputed, independently of the possible identification of some of their courses with cometary orbits; and they are very suitable for investigation by amateurs, nothing being required beyond a knowledge of the constellations, united to much care and patience. For the following table of the principal showers I am indebted to the kindness of Mr. Denning, as well as for many interesting and valuable remarks. He observes that the duration of many showers is still undetermined: some of them (as Leonids and Andromedes) being as brief as others (for instance, Aurigids and Aquarids) are prolonged; perhaps feebly and intermittently for months; a matter which requires, however, further investigation. The meteors are most frequent in the morning hours, and the latter half of the year. Observers should be especially careful to determine the direction of their paths, which should be marked on a map to ascertain the radiant point: the number in a given time, magnitude, length and swiftness of course, colour, and presence or absence of train, are all points to be noted. The following table comprises the principal periods and radiants. Those marked G are from Greg's Catalogue in Report of British Association, 1876: D indicates those observed by Denning. R.A. in degrees instead of time is usually employed in these determinations. In Dec. + signifies N, − S.

No.	Period and Duration	Radiant Point	Name or approx. Star	Authority	Other Dates, and Remarks
1	Jan. 2—3 (a.m.)	232+49	Quadrantids	G	Dec. 26—May 10. July 21.
2	Jan. 4—17 .	295+53	ψ Cyg. .	D	Oct. Nov.—Slow, trained.
3	Jan. 8—Mar. 31	175+14	β Leon. .	G	Nov.—Active.
4	Feb. 3—Mar. 31	158+29	Leo Min. .	G	Dec.
5	Feb. 6—Apr. 25	180+56	δ Urs. Maj.	G	Nov. and Dec.
6	Feb. 20 . .	263+36	ρ Herc. .	D	Morning.—Swift, streaks.
7	Mar. 2—Apr. 25	265+23	λ—μ Herc. .	G	July.—*Max.* Apr. 13 ?
8	Mar. 11—May 31	263+50	Draconids I.	G	Jan.
9	Apr. 1—May 25	204+56	ζ Urs. Maj.	G	Jul.—Continuation of No. 72.
10	Apr. 5—May 10.	272+35	Lyrids .	G	*Max.* Apr. 19-20.—May, Jun. Jul.
11	Apr. 12—June 30.	235+23.	Coronids .	G	Jan. Feb.—Formerly strong Apr.

No.	Period and Duration	Radiant Point	Name or approx. Star	Authority	Other Dates, and Remarks
12	Apr. 19—23	288+22	β Cyg.	D	Before sunrise only.
13	Apr. 19—23	294+43	δ Cyg.	D	Jul. Aug.
14	Apr. 19—23	284+44	π Cyg.	D	Jul. Aug.—Oct. Nov.
15	Apr.—May	228−4	β Lib.	D	Jan. Feb.—Slow.
16	Apr.—May	208−8	κ Lib.	D	Ditto.
17	Apr. 29—May 2	326−2	Aquarids	G	*Max.* May 2, a.m. (Tupman).
18	Jun. 7—Aug. 12	302+8	Aquilids	G	Rather slow.
19	Jun. 11—Aug. 31	317+62	α Cep.	G	Oct. and Nov.
20	Jun. 28—Aug. 25	282+60	Draconids II.	G	Apr. May, Nov.
21	Jun. 28—Sep. 15	338+17	Pegasids II.	G	Very long continued.
22	Jul. 1—Sep. 10	302+87	Polarids II.	G	Jan. Feb. and Mar.
23	Jul. 5—Aug. 31	309+48	Cygnids I.	G	Near α Cyg.—Active.
24	Jul. 5—Oct. 31	337+6	Aquarids	G	Very long continued.
25	Jul.—Aug.	12+70	ψ Cass.	D	Oct.
26	Jul.—Aug.	333+26	Pegasids I.	D	Sep.—Rapid.
27	Jul.—Oct.	290+70	δ Drac.	D	Very long continued.
28	Jul. 21—Sep. 3	7+33	Andromedes I.	G	Active.—Oct. Nov.
29	Jul. 23—Aug. 20	44+56	Perseids	G	*Max.* Aug. 10.—Comet III. 1862.
30	Jul. 27—29	341+13	δ Aquar.	D	Well observed, 1870. 1878.
31	Jul. 28—Sep. 6	170+54	β—γ Urs. Maj.	G	Well defined, 1869–71.
32	Jul. 30—Aug. 1	32+53	χ Pers.	D	Well observed, 1878.
33	Jul. Aug. Sep.	30+36	β Tri.	D	Well marked; long continued.
34	Aug 6—12	96+71	p, q Cam.	D	*Max.* Aug. 10 ?—Strong.
35	Aug. 6—12	70+64	c Cam.	D	Sep. Nov. Dec.
36	Aug. 6—12	62+48	μ Per.	D	Oct. Nov.
37	Aug. 6—12	62+37	ε Per.	D	Oct. Nov. Feb.
38	Aug. 6—Sep. 30	335+52	Lacertids	G	Jun. Jul.
39	Aug. 6—Oct. 10	359+13	Pegasids III.	G	Near γ.—Active.
40	Aug. 22—Oct. 20	46+35	Muscids	G	Active, long continued.
41	Aug.	76+45	α Aur.	D	Oct. Nov. Dec. Feb.
42	Sep. 1	306+54	ψ Cyg.	D	Swift, brilliant.
43	Sep 17—Nov. 25	84+48	Aurigids I.	G	Dec. Feb.
44	Sep. 25—Oct. 28	105+27	Gemellids	G	Very active in Oct.
45	Sep.—Oct.	97+45	Lyncids	D	Very swift, streaks.
46	Oct. 2	225+52	Quad.	D	Dec. Jan.—Slow, bright.
47	Oct. 2—19	133+79	Polaris	D	Jan. Apr. Jul. Aug.
48	Oct. 5—Nov. 13	39+15	Orionids	G	*Max.* Oct. 18–20.—Rich.
49	Oct. 14—20	31+9	Arietids	D	*Max.* Oct. 15 (1879).—Slow.
50	Oct. 15	46+26	Pleiad.	D	Jul. Aug.
51	Oct. 15—Dec. 14	46+55	γ Per.	G	Apparently for 2 months.
52	Oct. 21—Nov. 30	60+20	Taurids I.	G	Very rich; long continued.
53	Oct.	105+51	Lyn.	D	Jan.—Swift, short.
54	Oct.—Nov.	133+21	γ Can.	D	Dec. Jan.—Very swift.
55	Oct.—Nov.	105+12	β Can. Min.	D	Jan.—Active.
56	Oct.—Nov.	78+32	ψ Aur.	D	Aug.—Swift.
57	Oct.—Nov.	143+28	μ Leon.	D	Dec.—Swift.
58	Oct. 30—Nov. 1	43+22	ε Ari.	D	Slow, bright.—Well observed, 1877.
59	Oct. Nov. Dec.	120+15	β Can.	D	Long continued. Well defined radiant.
60	Nov. 9	102+73	p, q Cam.	D	Oct. 28.—Active, swift.
61	Nov. 11—15	149+23	Leonids	G	*Max.* Nov. 13.—Great display, 1866.

No.	Period and Duration	Radiant Point	Name or approx. Star	Authority	Other Dates, and Remarks
62	Nov. 24—Dec. 7	25+43	Andromedes II.	G	*Max.* Nov. 27.—Great display, 1872.
63	Nov. 25—28	155+36	Leominorids	D	Well observed, 1876.
64	Nov. 25—28	208+43	η Urs. Maj.	D	Well defined, swift, short.
65	Nov. 27	54+47	δ Per.	D	Aug. Mar.—Swift.
66	Nov. 27—Dec. 27	105+32	Geminids	G	*Max.* Dec. 10, 11.—Very rich.
67	Nov.—Dec.	145+7	o Leon.	D	Feb. Mar.—Swift, streaks.
68	Dec. 6—12	80+23	Taurids II.	D	Feb. Mar. Oct. Nov.
69	Dec. 13—Feb. 15	131+48	ι Urs. Maj.	G	*Max.* Jan. 15, a.m. ?—Oct. Nov.
70	Dec. 20—Feb. 26	116+87	Polarids I.	G	Mar. Jul. Aug.
71	Dec. 22—Feb. 6	180+35	Com. Ber.	G	*Max* Feb. 20 ?—Mar. Nov.
72	Dec. 27—Jan. 29	201+54	ζ Urs. Maj.	G	Compare No. 9—Aug.
73	Dec.—Jan.	222+41	β Boöt.	D	Apr. May.

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